• Volume 8D, Number 1, November 1959

CON... ...TH BUREAU
PASTU... ...D CROPS
LIB. REF.
RECD. 21 ... 1960
Ab. by
DATE 8.4.60
Ab. Articles: PP.

מוסד ויצמן למדעים במדעי הטבע ובטכנולוגיה בישראל • ירושלים • Jerusalem • The Weizmann Science Press of Israel

BULLETIN OF THE RESEARCH COUNCIL OF ISRAEL

Section D BOTANY

Bull. Res. Counc. of Israel. D. Bot.

Continuing the activities of the
Palestine Journal of Botany,
Jerusalem and Rehovot Series

Page

1 **Quelques additions à la Mycoflore d'Israel** *T. Rayss*

15 **Observations on the growth of Labyrinthula macrocystis** *M. Aschner and Shulamith Kogan*

25 **Physiologic races of oat crown rust identified in Israel in 1956–59** *I. Wahl*

31 **Further studies in atmospheric pollen in Jerusalem** *Naomi Feinbrun, Anna Rahat and J. Tas*

41 **Tuberculina persicina (Ditm.) Sacc. attacking rust fungi in Israel** *Rivka Barkai-Golan*

• Volume 8D, Number 1, November 1959

The Weizmann Science Press of Israel • Jerusalem מוסד ויצמן למדעים במדעי הטבע והטכנולוגיה בישראל • ירושלים

BULLETIN OF THE RESEARCH COUNCIL OF ISRAEL

Section D BOTANY

Bull. Res. Counc. of Israel. D. Bot.

Continuing the activities of the
Palestine Journal of Botany,
Jerusalem and Rehovot Series

Page

1 **Quelques additions à la Mycoflore d'Israel** *T. Rayss*

15 **Observations on the growth of Labyrinthula macrocystis** *M. Aschner and Shulamith Kogan*

25 **Physiologic races of oat crown rust identified in Israel in 1956–59** *I. Wahl*

31 **Further studies in atmospheric pollen in Jerusalem** *Naomi Feinbrun, Anna Rahat and J. Tas*

41 **Tuberculina persicina (Ditm.) Sacc. attacking rust fungi in Israel** *Rivka Barkai-Golan*

BULLETIN
OF THE RESEARCH COUNCIL
OF ISRAEL

—

MIRIAM BALABAN
Editor

—

EDITORIAL BOARDS

SECTION A
CHEMISTRY

Y. AVIDOR
E. D. BERGMANN
M. R. BLOCH
H. BERNSTEIN,
E. KATCHALSKI
A. KATZIR (KATCHALSKY)
G. STEIN
(*Chairman,*
Israel Chemical Society)

—

SECTION B
ZOOLOGY

H. MENDELSOHN
K. REICH
L. SACHS
A. YASHOUV

—

SECTION C
TECHNOLOGY

A. BANIEL
J. BRAVERMAN
A. DE LEEUW
M. LEWIN
M. REINER
A. TALMI
E. GOLDBERG, *Technion*
Publications Language Editor

—

SECTION D
BOTANY

N. FEINBRUN
N. LANDAU
H. OPPENHEIMER
T. RAYSS
I. REICHERT
M. ZOHARY

—

SECTION E
EXPERIMENTAL MEDICINE

S. ADLER
A. DE VRIES
A. FEIGENBAUM
M. RACHMILEWITZ
B. ZONDEK

—

SECTION F
MATHEMATICS and PHYSICS

A. DVORETZKY
J. GILLIS
F. OLLENDORFF
G. RACAH

—

SECTION G
GEO-SCIENCES

G. DESSAU
J. NEUMANN
L. PICARD

NOTICE TO CONTRIBUTORS

Contributors to the *Bulletin of the Research Council of Israel* should conform to the following recommendations of the editors of this journal in preparing manuscripts for the press.

Contributions must be original and should not have been published previously. When a paper has been accepted for publication, the author(s) may not publish it elsewhere unless permission is received from the Editor of this journal.

Papers may be submitted in English and in French.

MANUSCRIPT

General

Papers should be written as concisely as possible. MSS should be typewritten on one side only and double-spaced, with side margins not less than 2.5 cm wide. Pages, including those containing illustrations, references or tables, should be numbered.

The Editor reserves the right to return a MS to the author for retyping or any alterations. Authors should retain copies of their MS.

Spelling

Spelling should be based on the Oxford Dictionary and should be consistent throughout the paper. Geographic and proper names in particular should be checked for approved forms of spelling or transliteration.

Indications

Greek letters should be indicated in a legend preceding the MS, as well as by a pencil note in the margin on first appearance in the text.

When there is any room for confusion of symbols, they should be carefully differentiated, e.g. the letter "l"; "O" and "0".

Abbreviations

Titles of journals should be abbreviated according to the *World List of Scientific Periodicals.*

Abstract

Every paper must be accompanied by a brief but comprehensive abstract. Although the length of the abstract is left to the discretion of the author, 3% of the total length of the paper is suggested.

References

In Sections A and C, and in Letters to the Editor in all Sections, references are to be cited in the text by number, e.g. ... Taylor[3] ..., and are to be arranged in the order of appearance.

In Sections B, D, E, and G, the references are to be cited in the text by the author's name and date of publication in parentheses, e.g. .... (Taylor 1932)... If the author's name is already mentioned in the text, then the year only appears in the parenthesis, e.g. ... found by Taylor (1932).... The references in these Sections are to be arranged in alphabetical order.

In Section F, references are to be cited in the text by number in square brackets, e.g. ... Taylor[3] .., and are to be arranged in alphabetical order.

The following form should be used:

3. TAYLOR, G. I., 1932, *Proc. roy. Soc.*, A138, 41.

Book references should be prepared according to the following form:

4. JACKSON, F., 1930, *Thermodynamics*, 4th ed., Wiley, New York.

TYPOGRAPHY

In all matters of typography the form adopted in this issue should be followed. Particular attention should be given to position (of symbols, headings, etc.) and type specification.

ILLUSTRATIONS

Illustrations should be sent in a state suitable for direct photographic reproduction. Line drawings should be drawn in large scale with India ink on white drawing paper, bristol board, tracing paper, blue linen, or blue-lined graph paper. If the lettering cannot be drawn neatly by the author, he should indicate it in pencil for the guidance of the draftsman. Possible photographic reduction should be carefully considered when lettering and in other details.

Half-tone photographs should be on glossy contrast paper.

Illustrations should be mounted on separate sheets of paper on which the caption and figure number is typed. Each drawing and photograph should be identified on the back with the author's name and figure number.

The place in which the figure is to appear should be indicated in the margin of the MS.

PROOFS

Authors making revisions in proofs will be required to bear the costs thereof. Proofs should be returned to the Editor within 24 hours, otherwise no responsibility is assumed for the corrections of the author.

REPRINTS

Reprints may be ordered at the time the proof is returned. A table designating the cost of reprints may be obtained on request.

Orders in America should be addressed to Interscience Publishers Inc., New York, N. Y., and in England and Europe to Wm. Dawson and Sons, Ltd., Cannon House, Macklin Street, London, W. C 2, directly or through booksellers. — Annual subscription per section (four issues): IL. 6.000 ($6.00, £2.20). Single copy: IL. 1.500 ($1.50, 12s.) — Manuscripts should be addressed: The Editor, The Weizmann Science Press of Israel, P.O.B. 801, Jerusalem, 33 King George Ave. Telephone 62844

QUELQUES ADDITIONS A LA MYCOFLORE D'ISRAEL

T. RAYSS
Department of Botany, The Hebrew University of Jerusalem

ABSTRACT

In this additional contribution to the Mycoflora of Israel, notes are given on 42 species of fungi: for those which are parasites on higher plants 14 new hosts have been found; 21 species are new records for this country.

Of particular interest are 2 subterranean white truffles, *Terfezia leonis* Tul. and *Tirmania africana* Chat., found for the first time in Israel in the sub-desert regions, south of Beersheva.

The first was found in mycorrhizal association with roots of *Helianthemum sessiliflorum* (Desf.) Pers.; the second is known until now from the extreme south of Algeria and from Tunisia only.

These two fungi, now being gathered in large quantities in Israel by new immigrants from North Africa, are greatly appreciated for their excellent edible qualities.

Special attention has been devoted to the ascigerous stage of 3 important powdery mildews known generally in their conidial stage only: *Erysiphe cichoracearum* DC. on tobacco leaves, *Erysiphe communis* (Wallr.) Link on beet and *Uncinula necator* (Schwein.) Burr. on vine. Localities where the perithecia have been found are given, and the possible causes of their sudden appearance have been suggested.

Ce travail fait suite à une série de nos publications sur la Mycoflore de Palestine dans lesquelles nous avons étudié à peu près tous les groupes des champignons récoltés par nous et nos collaborateurs, à l'exception des Hyménomycètes et des Gastéromycètes. L'ensemble des données publiées par nous peut servir en quelque sorte de catalogue raisonné pour les champignons connus jusqu'à présent en Palestine, mais il est loin d'avoir épuisé le véritable inventaire mycologique de ce pays intéressant.

Nous continuons d'utiliser pour nos études l'abondant matérial que nous avons récolté—et continuons à récolter—au long et au large de notre pays; une partie de ce dernier attend encore d'être étudiée et contient sans doute pas mal d'espèces nouvelles et intéressantes. Ce matériel est conservé dans la Section Cryptogamique de l'Université Hébraïque à Jérusalem; seuls les champignons définitivement déterminés sont introduits dans l'herbier général de cette Institution. Toutes les espèces nouvelles ou particulièrement intéressantes ont été envoyées dans les herbiers les plus importants d'Europe et d'Amérique et les échantillons déterminés et récoltés en grand nombre nous servent de matériel d'échange contre les champignons d'autres pays.

Dans la présente contribution nous donnons les résultats d'étude de 42 espèces de champignons saprophytes, symbiotes ou parasites, appartenant aux Archimycètes,

Received July 12, 1959.

Phycomycètes, Ascomycètes et Ustilaginées. Vingt et une d'entre elles ont déjà paru dans nos publications précédentes mais sur d'autres plantes hospitalières: une indication spéciale leur est donnée dans le texte; vingt et une autres sont nouvelles pour notre mycoflore. Si nous ajoutons ce nombre à l'ensemble de 673 espèces de champignons étudiés dans nos publications précédentes (cf. Rayss 1955) et aux 66 espèces indiquées par nous pour la première fois dans notre étude des champignons du sol (Rayss et Borut 1958), le nombre total sera pour le moment 760. Il sera augmenté de beaucoup par les additions aux Péronosporacées, Urédinées et Deutéromycètes qui sont déjà en très grande partie étudiées et qui seront publiées prochainement.

Entre les champignons que nous présentons dans ce travail, les deux Terfez du Neghev méritent une attention spéciale: *Terfezia leonis* et *Tirmania africana*; ceci non seulement parce que ce sont des comestibles au goût délicat et de grande valeur nutritive, mais surtout parce qu'ils apparaissent en grande quantité dans une région désertique de notre pays où chaque apport spontané des produits alimentaires devrait être fortement apprécié; et encore ils poussent en mars–avril, plus tardivement que tous les autres champignons comestibles de notre pays. Le fait qu'ils ont échappé à l'attention des mycologues du pays est sans doute explicable par ce qu'ils sont hypogés et croissent à peu près à 20–30 centimètres sous la surface de la terre, sans qu'aucun signe perceptible permette d'indiquer leur présence. En plus, ces régions lointaines du Neghev n'ont pas été beaucoup explorées par les mycologues. Or, tout justement dans ces régions se trouvent actuellement de nombreux Juifs immigrés du Maroc, d'Algérie et de Tunisie qui ont su trouver dans les régions désertiques ressemblant à celles de leur pays d'origine, ces champignons précieux associés à la végétation qui leur est familière. Le *Tirmania africana* est surtout intéressant n'étant connu jusqu'à présent que dans le sud de l'Algérie et de la Tunisie.

Un intérêt d'une autre catégorie peut être suscité par les stades parfaits de trois Erysiphacées importantes qu'on connaît presqu'uniquement sous leur forme conidienne: l'*Erysiphe cichoracearum* sur les feuilles du tabac, l'*Erysiphe communis* sur les feuilles des betteraves et l'*Uncinula necator* sur les feuilles de la vigne.

Plusieurs hypothèses ont été émises par différents mycologues pour expliquer l'apparition subite des périthèces chez les Erysiphacées qui ne les produisent généralement point ou les forment très rarement (cf. Viennot–Bourgin 1952, Moreau 1954). Entre ces hypothèses, celle de l'hétérothallisme nous paraît être la plus probable pour les cas d'*Erysiphe cichoracearum* sur *Nicotiana tabacum* et probablement aussi d'*Erysiphe communis* sur les betteraves. L'apparition des périthèces y est capricieuse et le champignon peut demeurer plusieurs années sans en former; par contre, quand ils se forment, ils sont, comme l'observe Viennot–Bourgin (1958, p. 103), 'constamment disséminés bien que très nombreux'. Nous supposons ainsi que les périthèces apparaissent en grand nombre aux endroits où les mycélia de deux thalles viennent en contact. Pour l'*Erysiphe cichoracearum*, du reste, l'hétérothallisme a été expérimentalement démontré (Yarwood 1935).

Mais pour expliquer l'apparition des périthèces chez *Uncinula necator* sur la vigne nous pensons plutôt à l'influence des conditions physiques. Nous l'avons observé d'une façon assez convaincante à Kinnereth, à la fin du mois de décembre. Toutes les vignes de la localité se trouvaient en cette saison-ci déjà en défeuillaison et là où le champignon pouvait être encore décelé sur les feuilles desséchées, il se trouvait uniquement sous la forme conidienne; tandis que les vignes de la parcelle destinée à porter du raisin aux mois d'hiver qui ont subi en leur temps la taille appropriée, étaient recouvertes de feuilles vertes et relativement fraîches et le mildiou sur leur surface avait formé des périthèces en grand nombre. Nous mettons ceci en rapport avec le prolongement forcé des conditions de la sécheresse estivale et cette explication est conforme aux observations de Yossifovitch à Montpellier (1921) et de Nedeltscheff en Bulgarie (1924); de même, Français (1933) signale aux environs d'Epinal de nombreux périthèces sur les grains de Chasselas, à la suite d'un été chaud et sec; à la fin de l'été 1945, particulièrement sec, ils ont été constatés en grande abondance aux environs de Paris, etc. Par contre, nous ne pouvons pas expliquer l'apparition des périthèces chez nous par l'hypothèse de Viala (1893) qui suppose que les premières périodes froides de l'automne auraient une action favorisante sur leur formation; ni par celle d'Arnaud (1931) qui voit un rapport entre le déclin du feuillage de la vigne et la formation ascogène*.

Il va sans dire que nos suppositions sur les causes de la formation des périthèces chez les trois champignons qui nous intéressent ne sont que des hypothèses qui devraient être confirmées par des expériences appropriées.

En plus, cette contribution comporte un certain nombre de plantes hôtes nouvelles pour les champignons récoltés par nous. Telles sont:

Crepis bulbosa (L.) Tausch. pour *Erysiphe cichoracearum* DC.
Elymus caput-medusae L. pour *Erysiphe graminis* DC.
Eryngium creticum Lam. pour *Pleospora vulgaris* Niessl f. *disticha*
Fumaria judaica Boiss. pour *Entyloma fumariae* Schröter
Gagea commutata C. Koch pour *Ustilago ornithogali* (Schmidt et Kunze) Magnus
Glaucium grandiflorum Boiss. et Huet. pour *Entyloma fragosoi* Ciferri
Hippomarathrum boissieri Reut. et Haussk. pour *Pleospora media* Niessl
Pallenis spinosa (L.) Cass. pour *Leveillula taurica* (Lév.) Arnaud
Parietaria lusitanica L. pour *Entyloma parietariae* Rayss
Phagnalon rupestre (L.) DC. pour *Leveillula taurica* (Lév.) Arnaud
Ranunculus asiaticus L. pour *Entyloma microsporum* (Unger) Schröter
Ranunculus muricatus L. pour *Erysiphe nitida* (Wallr.) Rabenh.
Scandix pecten veneris L. pour *Synchytrium aureum* Schröter
Thrincia tuberosa (L.) DC. pour *Protomyces pachydermus* Thümen.

* Toutes les données sur la formation des périthèces chez *Uncinula necator* d'après Viennot — Bourgin (1949 et 1956).

PARTIE SPECIALE

ARCHIMYCETES ET PHYCOMYCETES

SYNCHYTRIACEAE

1(V).* *Synchytrium aureum* Schröter (ad interim)

Sur les feuilles de *Scandix pecten veneris* L., Aquabella près Jérusalem, 8.III.1945. Plante hospitalière nouvelle.

Spores durables: 105–225μ de diamètre.

2. *Synchytrium helianthemum* (Cook) Karling

Sur les feuilles d'*Helianthemum salicifolium* (L.) Mill., Innaba, 13.II.1942, coll. H. Chabelska; Wadi Fara, 1.III.1940, coll. H. Chabelska; Jérusalem, 25.II.1952; Herzlia, 5.II.1952.

Sur les feuilles d'*Helianthemum lasiocarpum* Willk., Ein Feshkha, 14.II.1940, coll. I. Amira.

Sur les feuilles d'*Helianthemum ledifolium* (L.) Mill., Jérusalem, 14.IV.1957, coll. I. Laor-Sonnenschein.

Nous avons précédemment décrit ce champignon (Rayss 1942) comme S. *aureum* mais n'étant pas convaincue de cette détermination nous avons envoyé notre matériel au spécialiste des *Synchytrium*, M.T. Cook et celui-ci à son tour, l'avait envoyé à Karling. N'ayant pas reçu de réponse, nous avons confié l'étude de ce champignon à notre élève, I. Laor-Sonnenschein. L'étude détaillée de Cook et Karling et, indépendamment d'eux, de Laor-Sonnenschein a montré qu'il s'agit d'une espèce nouvelle car notre champignon est macrocyclique et pas microcyclique comme *S. aureum* (Karling 1956, Laor-Sonnenschein 1959). Ceci est d'autant plus curieux que toutes les trois plantes hospitalières ont chez nous une vie très courte (février-mai). La morphologie, la cytologie et tous les cycles de développement de ce champignon intéressant, commençant par l'infection des plantes-hôtes et jusqu'à la formation des galles caractéristiques, ont été étudiés sur le vivant par I. Laor- Sonnenschein.

PHYSODERMATACEAE

3. *Physoderma leproides* (Trabut) Karling = *Urophlyctis leproides* (Trab.) Magn. (non *Ph. leproides* Lagerheim [voir Karling 1950])

Sur les feuilles et dans la partie supérieure des racines de *Beta vulgaris* L. formant des tumeurs volumineuses et déformantes: Kefar Warburg au sud de Tel-Aviv, 15.III.1954 et les années suivantes. Les betteraves fourragères sont fortement attaquées, les betteraves à sucre beaucoup plus rarement.

Kystes brun foncé, 32–36μ de diam. L'histoire, la répartition géographique de ce champignon rare et intéressant, sa morphologie, biologie, cycle évolutif, les voies d'infection et toutes les étapes de la formation de ces tumeurs ont fait l'objet d'une étude détaillée par notre élève R. Bernstein (1957).

OLPIDIACEAE

4. *Olpidium pendulum* Zopf

Sur les grains de pollen de *Pinus halepensis* Mill. flottant dans de petites flaques d'eau après la pluie, Jérusalem, 15.I.1957.

Spores durables, 15–18μ de diam., avec une grosse goutte d'huile au centre, en groupes de 4–5

* Les chiffres romains, placés après le numéro d'ordre, se rapportent à nos publications précédentes où cette même espèce a été indiquée sur d'autres plantes hospitalières. A savoir:

(I): Savulescu et Rayss (1935)
(II): Rayss (1940)
(III): Rayss (1947)
(IV): Rayss (1953)
(V): Rayss (1942)
(VI): Rayss (1945)
(VII): Rayss (1952)

à l'intérieur des grains de pollen; contenu incolore, membrane épaisse à double contour, la couche extérieure épaisse de 2μ. Tubes d'infection plus ou moins persistants.

PILOBOLACEAE

5(VI). *Pilobolus kleinii* van Tieghem var. *sphaerospora* Grove

Jérusalem, 12.I.1953. S'est développé au Laboratoire sur les bouses de vaches, dans une boîte métallique fermée.

Sporangiophores isolés, 1.5–2mm de haut; la vésicule elliptique sous le sporange et le bout du sporangiophore ont un contenu orangé. Sporanges noirs, 200–260μ de diam.; spores rondes, 10–19μ de diam., au contenu orangé et à membrane mince. Dans les mêmes cultures sous cloche se trouvent quelquefois aussi des sporanges à spores elliptiques.

THAMNIDIACEAE

6. *Thamnidium elegans* Link

Ramath-Rahel près Jérusalem, 11.XII.1953. Sur le crottin de mulets apporté par R. Reichman.

Sporanges portés par des sporangiophores longs de 1.5–2cm et larges de 25–35μ; columelles: 30–105×45–90μ, plus larges que dans la diagnose (62–90×50–76μ); diamètre des verticilles: 320–480μ; rameaux du premier ordre: 40–60×15–20μ; rameaux du dernier ordre: 4–6×2–3μ; sporangioles: 14–18μ, renfermant 2–4–6 spores; spores: 8–11×6–8μ.

ASCOMYCETES

PROTOMYCETACEAE

7. *Protomyces pachydermus* Thümen

Sur les feuilles de *Thrincia tuberosa* (L.) DC., Pardess Hanna, 2.III.1950 et 5.II.1957, coll. H. Chabelska. Plante hospitalière nouvelle.

Taches plus ou moins rondes sur les feuilles, commençant à se produire près des nervures et s'étendant ensuite latéralement; leur couleur est d'abord blanche ensuite brunâtre. Dans les coupes transversales traitées par le chlorure de zinc iodé se voit nettement dans la région du liber (phloème) le mycélium cénocytique et cloisonné du champignon, sur le trajet duquel se renflent des chlamydospores, plus ou moins rondes, disposées en chaînettes, 20–50μ de diam., à membrane incolore, 3–6μ d'épaisseur. Ces chlamydospores germent en émettant une vésicule plurinuclée où se forment des corpuscules différenciés en ascospores.

ASPERGILLACEAE

8. *Aspergillus nidulans* (Eidem) Wint.

Isolé de l'air à Tel-Aviv, 15.VII.1954, par R. Golan. Forme sur Czapek des colonies d'un vert foncé (revers rouge-pourpre), avec de nombreux périthèces se développant à partir du centre vers la périphérie. Les têtes conidiennes en colonnettes, 60–80×30–45μ, de couleur brun-cannelle, portées par des conidiophores courts, 100–130×3–5μ, aux parois lisses; les columelles sont hémisphériques et ont 8 à 15μ de diam. (dans la diagnose: 8 à 10μ); stérigmates en deux séries, portant des conidies rugueuses, 3–3.5μ de diam. Périthèces: 120–220μ de diam.; sphériques, entourés par de nombreuses cellules 'Hülle' typiques ayant pour la plupart 20μ de diam. Asques fugaces, 10–11×10–12μ contenant 8 spores: ascospores de couleur rouge-pourpre, lenticulaires, 4–4.5×3–4μ ornées de deux crêtes équatoriales distantes de 1μ l'une de l'autre.

9. *Aspergillus sydowi* (Bain. et Sart.) Thom et Church

Isolé de l'air à Tel-Aviv par R. Golan, déterminé le 8.VII.1954. Forme sur Czapek des colonies du type '*versicolor*' avec la couleur dominante bleue; têtes hémisphériques passant par tous les degrés de passage à la forme globuleuse qui est aussi la plus fréquente; le revers de la colonie rouge-

marron; têtes conidiennes: 50–100μ; conidiophores atteignant 500μ de longueur, 5–8μ de diam., incolores, aux parois lisses et épaisses; columelle 14–16μ de diam.; stérigmates en deux séries, 5–7μ de long.

Conidies globuleuses, 3–3.5μ de diam., spinescentes. Cellules 'Hülle' globuleuses, du type '*nidulans*'; point de sclérotes ni de périthèces. Diffère de *A. versicolor* par la couleur bleue-verte des têtes conidiennes et le revers rouge-marron.

TERFEZIACEAE

10. *Terfezia leonis* Tul.

Mifthakhim, Halutza et Zéhalim (au sud de Beersheva), 2.III.1956 (et aux mêmes endroits les années suivantes) sur des talus sablonneux-caillouteux, enfouis dans le sable à 20–30 centimètres de profondeur; liés intimément aux racines d'*Helianthemum sessiliflorum* (Desf.) Pers. avec lesquelles ils forment une symbiose mycorrhizienne.

Ce champignon se présente sous forme de tubercules ressemblant à des pommes de terre et atteignant jusqu'à 6cm de diam.; péridium lisse, clos, de couleur crème foncé, quelquefois presque noirâtre, aux nombreuses veines qui entourent des aréoles plus ou moins distinctes. Asques ovoïdes ou subglobuleux, 82–95 × 71–79μ renfermant généralement 4 à 6 ascospores; spores globuleuses, 16–24 × 20–22μ pourvues sur leur pourtour de verrues épaisses, tronquées, obtuses ou arrondies.

Excellent comestible et vendu en masse ces dernières années au marché de Beersheva.

11. *Tirmania africana* Chat.

Mifthakhim (S. de Beersheva), 2.III.1955, coll. N. Tadmor sur les crêtes des talus à la base desquels ont été récoltés les Terfezia, toujours enfouis profondément dans le sable.

Grands tubercules, 8 cm de diam. et davantage, blancs, au péridium lisse, bosselé; chair blanche, plus ou moins veinée; asques ovoïdes ou pyriformes, 77–88 × 40–45μ, renfermant 6 à 8 ascospores ellipsoïdes ou oblongues, uni-ou pluriguttulées, 15–20 × 12–15μ, lisses et incolores. Comestible excellent, plus apprécié encore que le *Terfezia*, mais se trouvant beaucoup plus rarement que ce dernier et n'apparaissant probablement pas toutes les années.

Le *Tirmania africana*, avec les deux espèces voisines, *T. ovalispora* Pat. et *T. cambonii* Chat., ont été connus jusqu'à présent seulement de l'extrême sud algérien et de Tunisie. Dernièrement le *Tirmania cambonii* a été trouvé aux environs de Kuwait (Dickson 1955), associé à l'*Helianthemum lippii*. La découverte de *Tirmania africana* au sud d' Israël élargit et complète l'aire de distribution de ce genre.

Terfezia leonis et *Tirmania africana* ont fait objet d'un mémoire spécial (Rayss 1959).

ERYSIPHACEAE

12(I. II. III. IV). *Erysiphe cichoracearum* DC. em. Salm.

Sur les feuilles de *Crepis bulbosa* (L.) Tausch., Jérusalem, 23.V.1957, coll. H. Chabelska. Plante hospitalière nouvelle.

Périthèces: 120–150μ de diam.; asques: 55–88 × 28–35μ; ascospores: 13–25 × 10–15μ, deux par asque.

Sur les feuilles de *Silybum marianum* (L.) Gaertn., Tel-Joseph, 27.IV.1940, coll. N. Naftolsky.

Périthèces: 110–130μ de diam.; asques: 60–75 × 20–35μ; spores, deux par asque, 20–26 × 12–16μ. A été indiqué sur cette plante hospitalière en Suisse.

Sur les feuilles de *Nicotiana tabacum* L., Jérusalem, 17.V.1955, coll. Sch. Borut.

Conidies: 20–30 × 7–16μ; périthèces: 110–180μ de diam.; asques: 55–67 × 30–48μ; spores: 15–25 × 11–16μ, généralement deux, rarement trois par asque.

Ce champignon, sous sa forme conidienne (*Oidium tabaci* Thüm.) est répandu dans presque tous les pays de culture de tabac et produit de grands dégâts aux plantations: les feuilles attaquées se dessèchent et perdent leur valeur commerciale (Jaczewski 1927). Il a été trouvé en Europe (surtout Europe méridionale), Afrique du Nord, Afrique orientale italienne (Cast. et Ciferri),

Afrique du Sud, Madagascar, les îles de la Réunion, île Maurice, Indes Néerlandaises, Japon (Hirata 1956), Formose; d'après Roger (1953), il est surtout fréquent dans l'hémisphère Sud et dans les régions tropicales. Toutefois, Stevenson (1926) dans sa liste des maladies des plantes en dehors d'Amérique l'indique seulement sous forme d'*Oidium tabaci*.

Par des infections expérimentales Blumer (1952) a montré que l'*Oidium tabaci* peut infecter *Cucumis sativa* et que réciproquement l'infection du tabac peut être faite par l'*Oidium* des concombres. Or, ce dernier présente la forme imparfaite de l'*Erysiphe polyphaga* Hammarlund: on peut donc supposer que l'*Oidium* du tabac devrait plutôt être rapporté à l'*E. polyphaga* Hamm. Ce dernier, selon Blumer (1952, p. 396), est tout proche de l'*E. cichoracearum* et s'en distingue par les dimensions légèrement plus petites de ses périthèces, un nombre plus petit d'asques et quelquefois par la présence de plus de deux spores par asque; mais surtout par sa polyphagie remarquable, mise en évidence par Hammarlund (1945). La supposition que l'*Oidium tabaci* appartiendrait à l'*E. polyphaga* n'est cependant pas confirmée par les expériences de Marcelli (1950).

Quant aux périthèces, ils ont été observés sur les feuilles du tabac à Formose (*Erysiphe tabaci* Sawada, espèce qui correspond en partie à l'*E. cichoracearum*), en Croatie (Scoric 1926), en Russie, Azerba'idjan et Uzbékistan (Naumov 1952), en Turquie*[1] et maintenant en Israël.

Cette rareté extrême des périthèces chez ce parasite important, de même que la polyphagie accidentelle de sa forme conidienne et le fait que les périthèces ont apparu chez nous en Mai et en Turquie en Octobre pourraient servir d'appui à notre hypothèse que ce champignon est hétérothallique.

13(I. II. III. IV). *Erysiphe communis* (Wallr.) Link

Sur les feuilles de *Beta vulgaris* L., Jérusalem, 14.VIII.1954; coll. Sch. Borut; Ghil'ad (Neghev), 11.IV.1955, coll. J. Palti. Périthèces: 76–120μ de diam., fulcres nombreux, inégaux; asques 56–67 $\times$30–40μ; spores, 2–3 par asque, 20–26$\times$12–16μ.

Nous avons déjà indiqué ce champignon sur les betteraves en Palestine (Rayss 1947), mais uniquement sous sa forme conidienne. Cette fois-ci nous trouvons à Jérusalem et à Ghil'ad de nombreux périthèces.

A notre connaissance, la forme parfaite a été trouvée jusqu'à présent en Tchécoslovaquie (Vanha 1903), en Russie (Jaczewski 1927, Muravjev, Newodowski), Grande Bretagne (1935), cf. Viennot-Bourgin 1956, Turquie (Bremer et al. 1947) et Göbelez (communication verbale) et à Iran (Viennot-Bourgin 1958).

14(I. II. III. IV). *Erysiphe graminis* DC.

Sur *Bromus alopecurus* Poir., Beth-Alpha, 23.IV.1931, coll. N. Naftolsky. Périthèces: 160–240μ de diam., asques: 65–95$\times$25–30μ; ascospores rarement formées, huit par asque, 12–17$\times$9–10μ.

Sur *Elymus caput-medusae* L., Petah-Tiqua, 23.V.1930, coll. N.Naftolsky. Plante hospitalière nouvelle. Périthèces: 160–220μ; asques: 70–85$\times$25–35μ; spores pas encore bien formées.

15(III). *Erysiphe nitida* (Wallr.) Rabenh.

Sur les feuilles de *Ranunculus muricatus* L., Wadi Antipatros, 2.VI.1923, coll. N. Naftolsky. Plante hospitalière nouvelle.

Conidies: 20–28$\times$10–16μ; périthèces: 80–110μ de diam., aux cellules pariétales 20–30μ de diam.; fulcres peu nombreux, insérés à la base du périthèce; asques: 40–65$\times$25–40μ; ascospores: 15$\times$12μ, jeunes.

16(II. IV). *Erysiphe pisi* DC.

Sur les feuilles et les tiges de *Lupinus luteus* L., Petah-Tiqva, 26.IV.1931, coll. N. Naftolsky.

Conidies 25–30$\times$8–14μ; périthèces: 100–132μ de diam., avec des fulcres courbés au sommet, atteignant et quelquefois dépassant le diamètre du périthèce; asques 5–7 dans chaque périthèce, 57–60$\times$25–40μ, renfermant 4–5 ascospores; spores: 23–25$\times$10–16μ.

Blumer (1933, p.190) fait une comparaison intéressante entre l'*Erysiphe martii* et l'*E. pisi*: les

* Dr. Göbelez les a récoltés à Samsun le 15.X.1959 et nous a obligeamment envoyé son matériel. Nous tenons à lui exprimer par cette voie notre reconnaissance.

périthèces du premier sont réunis par leurs longs fulcres en une espèce de feutre lâche facilement détachable de la plante hospitalière, tandis que chez *E. pisi* les fulcres sont plus courts et forment des croûtes appliquées contre la surface de la plante. L'aspect de nos plantes malades confirme cette observation.

17(I. II. III. IV). *Erysiphe umbelliferarum* de Bary

Sur les feuilles de *Falcaria vulgaris* Bernh., Jérusalem, 15.VI.1958, coll. Sch. Borut.

Conidies: 27–38 × 11–18μ; périthèces: 88–106μ de diam.; asques: 50–60 × 28–35μ; ascospores: 22–28 × 11–15μ, trois à cinq par asque.

18(I. II. III. IV). *Leveillula taurica* (Lév.) Arnaud

Sur les feuilles de *Pallenis spinosa* (L.) Cass., Ramath-Rachel, 20.VII. 1954, coll. Sch. Boneh-Borut. Plante hospitalière nouvelle.

Conidies: 40–60 × 14–20μ; périthèces: 200–240μ de diam.; asques: 95–100 × 30–40μ; ascospores: 25–38 × 14–20μ.

Sur cette même plante hospitalière a été trouvé en Dalmatie l'*Erysiphe cichoracearum* (Jaczewski 1927, p.205); à notre connaissance, le *Leveillula* n'a pas encore été indiqué.

Sur les feuilles de *Phagnalon rupestre* (L.) DC., Safed, 22. VIII. 1953. Plante hospitalière nouvelle.

Conidies rares, 45–50 × 16–18μ; périthèces: 140–240μ de diam.; asques: 60–70 × 24–30μ; ascospores: 30–35 × 14–16μ.

19(I. II. III). *Sphaerotheca fuliginea* (Schlechtendal) Salmon

Sur les tiges et les feuilles d'*Erigeron crispus* Pourret, Hanita, 5.II.1955.

Conidies: 22–30 × 10–15μ, fortement attaquées par *Cicinnobolus cesatii;* périthèces: 77–100μ de diam.; asques: 45–90 × 40–70μ; ascospores, huit par asque: 14–25 × 12–20μ.

20. *Sphaerotheca fusca* (Fries) em. Blumer = *Sph. castagnei* Lév. pro parte

Sur les feuilles de *Senecio vernalis* W. K., Tel-Aviv, 3.I.1933, coll. N. Naftolsky, Rehovot, 24.III.1951, Pardess-Hanna, 20.III.1951.

Mycélium aérien brun; périthèces 100–125μ de diam., aux cellules pariétales de 25–30 × 12–15μ; asques: 60–90 × 50–75μ; spores, huit par asque: 17–22 × 11–16μ.

Sur les différentes espèces du genre *Senecio* ont été indiquées les Erysiphacées suivantes: *Leveillula taurica*, *Erysiphe cichoracearum*, *E. fischeri*, *Sphaerotheca fuliginea*, *Sph. castagnei*, *Sph. macularis* (?) et *Sph. fusca*. Nous avons précédemment trouvé dans notre pays sur *Senecio vernalis* l'*Erysiphe fischeri* Blumer (Savulescu et Rayss 1935). Cette fois-ci nous trouvons sur la même plante hospitalière un *Sphaerotheca* qui correspond par tous ses caractères au *Sph. fusca*, espèce séparée encore par Fries de *Sph. fuliginea* sensu lato et qui réunit tous les *Sphaerotheca* attaquant les différentes espèces de *Senecio*. Blumer (1933 p. 118) en donne une liste assez grande et remarque que les seneçons attaqués par *Sph. fusca* appartiennent "exclusivement" aux sections Reniformis et Sarraceni établies au sein de ce genre par Hegi (1928, VI.2, pp. 726–727). Or, *Senecio vernalis* appartient, d'après Hegi (l. c.), à la section Annui et il en est de même pour *Senecio vulgaris* sur lequel Saccardo (1898, XIII, p. 1145) et Oudemans (1923, IV, p. 1042) indiquent le *Sphaerotheca castagnei*, synonyme de *Sph. fusca*. La remarque de Blumer doit ainsi être étendue aussi à la section Annui.

D'autre part, dans notre pays se trouvent et le *Senecio vulgaris* et le *S. vernalis*, mais la seule espèce que nous avons trouvée jusqu'à présent attaquée par *Sph. fusca* est le *S. vernalis*.

21(III). *Uncinula necator* (Schwein.) Burr.

Sur les feuilles de *Vitis vinifera* L., vigne Chasselas cultivée en treille, Kinnereth, 25.XII.1954.

Périthèces: 70–100μ de diam., aux cellules péridiales larges de 15–26μ, pourvus de fulcres longs, foncés à leur base et s'enroulant en crosse à leur sommet. Asques: 30–50 × 16–42μ; ascospores, six par asque, encore jeunes, 14–20 × 8–10μ.

Ce mildiou est répandu dans les vignobles d'Israël sous sa forme conidienne, mais c'est pour la première fois que nous trouvons la forme parfaite et encore en grande quantité.

Une expérience intéressante a été faite à Kinnereth pour obtenir, par une taille appropriée, du très bon raisin de table pour les mois de décembre et de janvier. Quand nous avons visité les parcelles d'expérience, toutes les vignes aux alentours étaient déjà dépourvues de feuilles et de fruits et seulement celles qui ont subi la taille correspondante étaient recouvertes de feuilles vertes et fraîches et portaient de belles grappes en grande quantité. C'est sur les feuilles tardives de ces vignes que le mildiou a formé plusieurs périthèces.

Les périthèces d'*Uncinula necator* se forment d'une façon constante sur le continent américain, mais en Europe ils apparaissent sporadiquement*. Ils ont été indiqués en France par Couderc (1893), Viala (1894), Prillieux (1897), Arnaud (1917) Yossifovitsch (1923), Jaczewsky et autres; en Allemagne par Lüstner (1901); en Italie par Peglion (1909), Madaluni (1957); en Roumanie par Istvanffi (1904); en Bulgarie par Nedeltcheff (1924); en Turquie par Göbelez (communication verbale); en Russie par Antokolskaja (1925); en Suisse par Faës et Stachelin (1927) et par Terrier (1950), qui voit dans le développement extraordinaire de la forme ascogène en 1949 une conséquence d'un automne sec et chaud (Stations fédérales, etc. 1950). Mayor (1958) rapporte que les périthèces dans la région neuchâteloise ne se forment pas régulièrement chaque année; ils peuvent manquer pendant plusieurs années ou être en très petit nombre; parfois au contraire ils sont en très grande quantité. La forme parfaite reste ainsi partout rare et accidentelle et différentes explications ont été suggérées pour expliquer leur apparition fortuite. Nous en avons indiqué quelques-unes dans notre préface (page 3).

Une étude intéressante a été entreprise par Madaluni (1957) en Italie sur le cycle biologique d'*Uncinula necator*, le développement des périthèces en nature et dans les conditions d'expérience et sur la libération des asques et des ascospores. Dans cette étude préliminaire l'auteur n'a pas encore réussi à obtenir la germination des ascospores, mais les recherches continuent et promettent des résultats intéressants. L'auteur suppose que les périthèces qui apparaissent toujours vers la fin de l'été permettent au champignon à résister aux rigueurs de l'hiver et contribuent ainsi à la propagation de l'infection au printemps suivant.

DOTHIDEACEAE

22(II. III. IV). *Dothidella trifolii* Baylis-Elliott et Stansfield

Sur les feuilles de *Trifolium physodes* Stev., sous état conidien = *Polythrincium trifolii*, Tel-Aviv, bords de l'Yarkon, 14.IV.1931, coll. N. Naftolski.

PLEOSPORACEAE

23(II. III. IV). *Pleospora herbarum* (Pers.) Rabenh.

Sur les feuilles, les tiges et les siliques d'*Acacia cyanophylla* Lindl., Even-Jéhuda, 8.II.1958.

Périthèces: 200–220μ de diam.; asques: 70–110 × 12–20μ; ascospores: 27–38 × 13–15μ légèrement retrécies à leur milieu, avec 7 cloisons transversales et 1–2 longitudinales.

Sur les phylloclades de *Ruscus hypoglossum* L., Jérusalem, 26.I.1955, coll. H. Chabelska.

Périthèces: 200–320μ de diam.; asques: 130–140 × 23–25μ; ascospores: 28–35 × 14–18μ, un peu plus larges que ne l'indique la diagnose (13–16μ).

24(III). *Pleospora media* Niessl

Sur les tiges sèches d'*Hippomarathrum boissieri* Reut. et Hausskn., Benei-Berak, 21.III. 1930, coll. N. Naftolsky.

Périthèces: 180–200μ de diam.; asques: 62–92 × 14–15μ; ascospores: 20–24 × 8–11μ, pourvues de 5 cloisons transversales. Par ses spores foncées et par la présence de la cloison longitudinale bien évidente notre champignon correspond au *P. media* et pas au *P. vulgaris*. Les dimensions de nos périthèces sont un peu plus petites que ne l'indique la diagnose (250–300μ).

* Les indications qui suivent sont d'après Jaczewsky (1927), Viennot-Bourgin (1952), Naumov (1952) et Moreau (1954).

25. *Pleospora vulgaris* Niessl (recte *P. scrophulariae* [Desm.] v. Höhn.)*

Sur les tiges mortes de *Cichorium pumilum* Jacq., Hanita, 5.II.1955.

Périthèces: 250–300μ de diam.; asques: 100–120 × 10–13μ; ascospores: 18–21 × 6–10μ; huit par asque, pourvues de cinq cloisons transversales et d'un retrécissement bien évident au milieu de la spore; les quatre cellules médianes sont pourvues d'une cloison longitudinale, les deux cellules terminales ne sont généralement pas cloisonnées en long; paraphyses: 2–3μ de diam.

Cette espèce a été indiquée au Maroc (Maire et Werner 1937) sur *Cichorium divaricatum* = *C. pumilum*, donc sur la même plante hospitalière; par contre, nous avons précédemment trouvé sur ce même hôte le *Pleospora herbarum* (Rayss 1940, p.328); il héberge donc chez nous deux espèces de *Pleospora*, une dont les périthèces ont le diamètre de 225–250μ et les ascospores sont de 25–30 × 14–16μ pourvues de 7 cloisons (*Pl. herbarum*) et l'autre, aux périthèces un peu plus grands (250–300μ de diam.) et aux spores plus petites (18–21 × 6–10μ) pourvues seulement de cinq cloisons transversales.

Pl. vulgaris forma *monosticha* Niessl

Sur les tiges de *Sambucus nigra* L., Jérusalem, 15.XI.1957, coll. J. Pereg.

Périthèces : 181–264μ de diam., hauts de 148–230μ; asques: 88– 140 × 9–10μ ; ascospores : 15–20 × 5–7μ, retrécies à leur milieu, pourvues de 5 cloisons transversales et disposées en une seule rangée.

Pl. vulgaris f. *disticha* Niessl

Sur les tiges et les involucres floraux d'*Eryngium creticum* Lam., Rehovot, 17.III.1930, coll. N. Naftolsky. Plante hospitalière nouvelle.

Périthèces: 200–250μ de diam.; asques: 70–90 × 10–12μ; ascospores: 20–23 × 6–8μ, pourvues de 5 cloisons transversales; paraphyses plus longues que les asques. Les spores sont arrangées dans les asques en 2 rangées.

HYALOSCYPHACEAE

26. *Dasyscypha virginea* (Batsch) Fuck. = *Lachnum agaricinum* Retz = *Lachnum virgineum* (Fr.) Karst.

f. *carpophila* Pers. et Fr.

Sur les cupules de *Quercus calliprinos* Webb, Nes-Harim (Judée), 11.II.1959.

Petits réceptacles blancs et élégants, larges de 0.5–1 mm (nos valeurs sont plus petites que celles indiquées pour la forme typique (2–4 mm) mais la forme *carpophila* les a toujours plus petites), en forme d'urne ou d'une petite coupe, portée par un stipe long de 2–3 mm (un peu plus long que ne le veut la diagnose = 0.3–2 mm), recouverts à l'extérieur par de poils pluricellulaires élargis au sommet, longs de 60–70μ et ayant 3μ de diam.; asques allongés, cylindriques, un peu arrondis au sommet, octosporés, 60–65 × 4.5–5.5μ; leur ouverture seule se colore en bleu par l'iode; paraphyses lancéolées, aigües au sommet, dépassant les asques, 80–88 × 3.5–4.5μ; ascospores hyalines, aciculaires, continues, droites, 7–8.5 × 1–2.2μ. Cristaux rares, souvent absents.

La forme *carpophila* a été indiquée en Allemagne sur les cupules de *Fagus silvatica*.

HELOTIACEAE

27. *Stamnaria equiseti* (Hoffm.) Sacc.

Sur les tiges d'*Equisetum ramosissimum* Desf., Petah-Tiqva, 14.IV.1931, coll. N. Naftolsky.

Réceptacles incolores, roses, ou d'un jaune orangé, de consistance gélatineuse-cireuse, groupés en zones circulaires, 400–1000μ de diam., ayant la forme d'une petite coupe pédicellée; asques octosporés, 100–120 × 12–16μ; paraphyses pluricellulaires, filiformes, élargis à leur sommet et renfermant plusieurs gouttelettes rougeâtres; ascospores: 15–20 × 5–7μ; le pore des asques bleuit par l'iode.

* Cette espèce devrait s'appeler à présent *Pleospora scrophulariae* (Desm.) v. Höhn. = *Sphaeria scrophulariae* Desm. = *Pleospora vulgaris* Niessl (cf. Müller 1951), mais n'ayant pas sous main la litérature correspondante nous nous permettons d'utiliser provisoirement le vieux nom de *Pleospora vulgaris* qui est, du reste, encore d'usage général.

HUMARIACEAE

28. *Barlaea persoonii* Crouan

Miqve-Israel, sur le sol, entre les mousses, 19.XIII.1957.

Réceptacles sessiles, charnus, d'un violet foncé, 3 à 7 mm de diamètre, lisses en dehors; asques cylindriques, 190–200 × 14–15μ; paraphyses filiformes, peu courbées, incolores; ascospores sphériques, lisses, renfermant une, deux ou plusieurs gouttelettes d'huile, 8–10μ de diamètre, disposées en une seule rangée.

29. *Scutellinia pseudotrechyspora* (Schröt.) Lambotte (cnf. Le Gal 1953 p. 102) = *Lachnea pseudotrechyspora* Schröter

Alma (Haute Galilée), sur le sol entre les mousses, 20.IV.1957, coll. A. Grizi.

Réceptacles orbiculaires-disciformes, rouge-cinabre, 2–5 mm de diam., garnis de poils courts et épais, au sommet pointu, cloisonnés et ramifiés çà et là dans leur tiers supérieur, 167–268 × 13–22μ; asques cylindriques, à 8 spores unisériées, 165–220 × 16–20μ; paraphyses longues de 167–200μ, larges à leur base de 2–3μ et renflées à leur sommet jusqu'à 7–12μ; ascospores largement elliptiques, verruqueuses, avec une-deux gouttes d'huile à leur intérieur, 15–20 × 12–14μ.

30. *Scutellinia umbrata* (Fries) Lambotte = *Lachnea umbrata* (Fries) Phill.

Wadi Rubin, sur terre humide, 18.III.1954, coll. J. Werner.

Réceptacles sessiles, 3–6 mm de diam., concaves ou à surface plane, rouge-cinabre, jaune-brunâtre à l'extérieur, recouverts de poils courts, bruns, cloisonnés et assez droits, 120–150 × 10–15μ (ces poils sont plus larges que ne l'indique la diagnose: 7–9μ); asques cylindriques, atténués à leur base et arrondis à leur sommet, 240–260 × 15–19μ, octosporés; paraphyses longues de 280μ, 5μ de diam. à leur base, atteignant la largeur de 10μ à leur extrémité, remplies de gouttelettes jaunes; par l'iode, les asques se colorent en jaune et les paraphyses en brun; ascospores elliptiques, lisses, 11–15 × 9–10μ, renfermant quelquefois une grosse goutte d'huile.

PLICARIACEAE

31. *Pustularia stevensoniana* (Ellis) Rehm

Jérusalem, 21.II.1956, poussant sur carton pourri, dans un garage, coll. J. Ben-Schaul.

Réceptacles sessiles, 5–8 cm de diam., blancs et glabres en dehors, brun-vélouté sur leur face hyméniale; asques 210–300 × 10–13μ, se colorant fortement par l'iode; paraphyses filamenteuses, septées, s'élargissant jusqu'à 5μ dans leur partie supérieure; ascospores: 12–17 × 7–8μ, elliptiques, incolores, sans gouttelettes d'huile.

HELVELLACEAE

32. *Helvella crispa* (Scop.) Fries

Hanita (Haute Galilée), 5.II.1955, dans la fôret de *Pinus*.

Grands champignons blancs et fragiles atteignant la hauteur de 8 à 10 cm et davantage (d'après Velenovsky: 3–7 cm); chapeau campanulé, à 2–3 rarement 4 lobes contournés, 2–4 cm de diam., d'un blanc sale légèrement brunâtre; stipe profondément silloné, lacuneux, blanchissant avec l'âge, 4–6 cm de haut, 1.8–2.2 cm de large. Asques cylindriques, arrondis au sommet, 160–250 × 14–18μ; paraphyses ramifiées et cloisonnées, 2–3μ de diam., élargies à leur sommet; ascospores hyalines, 15–20 × 10–12μ, unisériées. Bon comestible.

BASIDIOMYCETES: USTILAGINALES

TILLETIACEAE

33. *Entyloma fragosoi* Cifferi

Dans les feuilles de *Glaucium grandiflorum* Boiss. et Huet., Jérusalem, 24.III.1937. Plante hospitalière nouvelle.

Taches rondes, quelquefois coalescentes, zonées, sèches. Spores d'un jaune-doré, brunes en masse, 15–20 × 10–13μ, en chainettes, à épispore double: endospore 1.5–2μ de diam., brunâtre; exospore

0.5μ de diam., hyalin. Se distingue de *E. glauci* Dangeard par ses taches sèches et zonées et par ses spores plus grandes (celles d'*E. glauci:* 10–16μ).

34. *Entyloma fumariae* Schröter

Dans les feuilles de *Fumaria judaica* Boiss., Gesher Haziv (Haute Galilée), 23.III.1955. Plante hospitalière nouvelle.

Taches circulaires ou elliptiques, blanches, bordées de brun au début, devenant par la suite brunâtres, 1–2 mm de diam. Spores rondes ou légèrement elliptiques, 10–14 × 9–12μ, à épispore lisse inégalement épaissi, brunâtre, épais de 1–2μ. Conidies, pas encore connues chez cette espèce, forment un léger duvet sur la face des taches jeunes: elles sont cylindriques ou filiformes, légèrement courbées, 15–25 × 2–3μ.

Cette espèce a été décrite sur *Fumaria muralis* à Madère et retrouvée sur *Fumaria* sp. à Malte et en Italie et sur *Fumaria parviflora* aux Indes (Mundkur et Thirumalachar 1952 p.68); ce dernier champignon a des spores légèrement plus grandes que les nôtres (jusqu'à 17μ).

Notre champignon correspond entièrement à la diagnose originale mais dans laquelle les conidies n'ont pas été indiquées.

35. *Entyloma microsporum* (Unger) Schröter

Sur les feuilles de *Ranunculus asiaticus* L., Wadi Fedjaz, 24.II.1957, coll. A. Grizi.

Sores recouverts par l'épiderme des feuilles et formant sur leur surface des pustules plus ou moins proéminentes, 2–5 mm de diam.; spores jeunes, groupées souvent en chaînettes, incluses dans la cellule-mère qui mesure 12–22μ de diam., puis libres, 10–13μ de diam.; épispore inégalement épaissi, hyalin, stratifié, ayant 2 à 7μ d'épaisseur.

Nous avons trouvé précédemment sur *Ranunculus asiaticus* l'*Entyloma ranunculorum* Liro, dont l'épispore n'a que 1–2μ d'épaisseur (Rayss 1952).

36(VII). *Entyloma parietariae* Rayss

Dans les feuilles de *Parietaria lusitanica* L., Désert de Judée, 13.II.1940. Plante hospitalière nouvelle
Spores: 12–15 × 10–12μ.

37(I. VII). *Ustilago avenae* (Pers.) Rostrup

Dans les panicules d'*Avena sativa* L., Nahlath-Itzhak, 4.III.1933, coll. N. Naftolsky.

Chlamydospores: 6–8 × 5–7μ, à membrane munie de petites verrucosités éparses. Charbonnement des panicules presque complet.

38(I. VII). *Ustilago bromivora* (Tul.) F.v. Waldh. f. sp. *U. bromi-macrostachyi* Kze.

Dans les épis de *Bromus lanceolatus* Roth. (= *B. macrostachys* Desf.), Afula, 27.IV.1930, coll. N. Naftolsky.

Spores verruqueuses, 8–12 × 9–11μ.

39(I). *Ustilago levis* (Kellerm. et Swingle) Magn.

Dans les inflorescences d'*Avena sativa* L. Nahlath-Itzhak, 4.III.1933, coll. N. Naftolsky.
Spores lisses, 6–8 × 4–6μ.

40(I). *Ustilago nuda* (Jens.) Rostrup

Dans les épis d'*Hordeum sativum* Jess., Nahlath- Itzhak, 25. II. 1933, coll. N. Naftolsky.
Spores verruqueuses, masse sporifère brun olive. Spores: 7–9μ.

41(I). *Ustilago ornithogali* (Schmidt et Kunze) Magnus

Sur les feuilles de *Gagea commutata* C. Koch, Jérusalem, 10.III.1953, coll. Sh. Nahmony. Plante hospitalière nouvelle.

Pustules sous-épidermiques ovales, closes au début; spores irrégulières, sphériques, elliptiques ou anguleuses, quelquefois pyriformes, 15–25 × 10–16μ, à épispore mince et lisse.

42(VII). *Sphacelotheca cruenta* (Kühn) Potter

Dans les épis de *Sorghum annuum* Pers., variétés cultivées 'Honey-Laoti', et 'Red Columbina', Neve Yaar, 27.VIII.1955, coll. I. Palti.

Spores fertiles: 6–10μ atteignant quelquefois 12μ de diam., lisses; spores stériles globuleuses, isolées ou en amas plus ou moins sphériques, 10–14μ de diam.; columelles allongées et arquées.

BIBLIOGRAPHIE

AINSWORTH, G. G. AND SAMPSON, K., 1950, The British Smut Fungi (Ustilaginales), *Commonwealth mycol. Inst.*, Kew.

BERNSTEIN, R., 1957, Studies on the life history of *Physoderma leproides* Trabut (non *P. leproides* Lagerheim) Karling (= *Urophlyctis leproides* (Trab.) Magn.) *Bull. Res. Counc. of Israel*, **6D**, 46—52.

BLUMER, S., 1933, Die Erysiphaceen Mitteleuropas, *Beitr. Kryptogamenflora d. Schweiz*, **7**(1), Zürich.

BLUMER, S., 1951, Beiträge zur Kenntnis der Erysiphaceen. 2 Mitteilung, *Phytopathol. Zeitschr.*, **18**(1), 101–110.

BLUMER, S., 1952, Beiträge zur Spezialisation der Erysiphaceen, *Ber. schweizer. bot. Ges.*, **62**, 384–401.

BREMER, H., ISMEN, H., KAREL, G. UND OZKAN, H. M., 1947, Beiträge zur Kenntnis der parasitischen Pilze der Türkei. I. Schizomycetes, Phycomycetes und Ascomycetes, *Rev. de la Fac. des Sci. de l'Université d'Istanbul*, Ser. B, **12**, 122–172.

BRESADOLA, J., 1932, *Iconographia Mycologica*, **24**, Mediolani.

BUEREN, G. v., 1951, Die schweizerischen Protomycetaceen, *Beitr. Kryptogamenflora d. Schweiz*, **5**(1),Bern.

CHATIN, AD., 1892, *La Truffe*, Paris.

CIFERRI, R., 1938, Ustilaginales, *Flora Italica Cryptogama*, I. *Fungi*, fasc. **17.**

CLINTON, G. P., 1904, North American Ustilagineae, *Proc. Boston Soc. nat. Hist.*, **31**, 329–529.

DICKSON, V., 1955, *The Wild Flowers of Kuwait and Bahrain*, London.

HAMMARLUND, C., 1945, Beiträge zur Revision einiger imperfekten Mehltau-Arten. *Erysiphe polyphaga* nov. sp. (Vorläufige Mitteilung), *Bot. Zeit.*

HEGI, G., 1928, *Illustrierte Flora von Mittel-Europa*, **6**(2), München.

HEIM, R., 1957, *Les Champignons d'Europe*, **1 & 2**, Paris.

HIRATA, K., 1956, Additional list of the powdery mildews in the central Japan, *Ann. phytopathol. Soc. of Japan*, **21**(2–3), 87–91.

JACZEWSKY, A. A., 1927, *Karmanii Opreďelitel Gribov*, **2**, Leningrad (en russe).

KARLING, J. S, 1950, The genus *Physoderma* (Chytridiales), *Lloydia*, **12**, 29-71.

KARLING, J. S., 1956, New and unidentified species of *Synchytrium*. IV, *Sydowia*, **10**, 132–145.

LAOR-SONNENSCHEIN, I., 1959, Cytological and biological investigations on *Synchytrium helianthemum* (Cook) Karling (en préparation).

LE GAL, M., 1953, Les Discomycètes de Madagascar, *Prodrome à une Flore myc. de Madagascar*, **4**, Paris.

LENDNER, A., 1908, *Les Mucorinées de la Suisse*, Berne.

MADALUNI, A. L., 1957, Nota preliminare su alcune osservazioni relative al ciclo biologico dell' Oidio delle vite, *Boll. Staz. di Patol. veget.* **14**, 1956, 323–331.

MAIRE, R. ET WERNER, R. G., 1937, Fungi maroccani. Catalogue raisonné des champignons connus jusqu'à présent au Maroc, *Mém. Soc. Sci. nat. Maroc*, **45.**

MARCELLI, E., 1950, Ulteriori osservazioni sulla specializzazione dell' "Oidio" del tabacco, *Tabacco*, **54**, 615, 330–332.
MAYOR, E., 1958, Catalogue des Péronosporales, Taphrinales, Erysiphacées, Ustilaginales et Urédinales du canton de Neuchâtel, *Mém. Soc. Neuchâteloise Sci. nat.*, **9**, fasc. 1.
MOREAU, F., 1954, Les Champignons, II. *Encyclopédie Mycologique*, **23**, Paris.
MUELLER, E., 1951, Die schweizerischen Arten der Gattungen *Clathrospora, Pleospora, Pseudoplea* und *Pyrenophora, Sydowia, Ann. Myc., Ser.* 2, **5**, 248–310.
MUNDKUR, B. B. AND THIRUMALACHAR, M. J., 1952, *Ustilaginales of India*, Commonwealth mycol. Inst., Kew.
NANNFELDT, J. A., 1932, Studien über die Morphologie und Systematik der nicht-lichenisierten inoperculaten Discomyceten, *Nova Acta Regiae Soc. Sci. upsal.*, IV, **8**(2).
NAUMOV, N. A., 1939, Clés des Mucorinées, *Encyclopédie Mycologique*, **9**, Paris.
NAUMOV, N. A., 1952, *Bolezni Selskohosaistvenih Rastenii*, Moskwa (en russe).
OUDEMANS, C. A. J. A., 1923, *Enumeratio Systematica Fungorum*, **4**, Haguae.
RAYSS, T., 1940, Nouvelle contribution à l'étude de la Mycoflore de Palestine (Deuxième partie), *Palest. J. Bot. Jerusalem*, **1**, 313–335.
RAYSS, T., 1942, On some lower fungi of Palestine, *Palest. J. Bot. Jerusalem*, **2**, 247–249.
RAYSS, T., 1945, Nouvelle contribution à l'étude de la Mycoflore de Palestine (Troisième partie), *Palest. J. Bot. Jerusalem*, **3**, 151–166.
RAYSS, T., 1947, Nouvelle contribution à l'étude de la Mycoflore de Palestine (Quatrième partie), *Palest. J. Bot. Jerusalem*, **4**, 59–76.
RAYSS, T., 1952, Etude des quelques Ustilaginées récoltées en Palestine, *Palest. J. Bot. Jerusalem* **5**, 229–236.
RAYSS, T., 1953, Nouvelle contribution à l'étude de la Mycoflore de Palestine (Sixième partie), *Palest. J. Bot. Jerusalem*, **6**, 37–46.
RAYSS, T., 1955, Nouvelle contribution à la connaissance des Deutéromycètes de Palestine, *Bull. Res. Counc. of Israel*, **5D**, 37–46.
RAYSS, T., 1959, Champignons hypogés dans les régions désertiques d'Israël, *Omagiu lui Traian Savulescu*, Bucuresti, pp. 655-659.
RAYSS, T. AND BORUT, S., 1958, Contribution to the knowledge of soil fungi in Israel, *Mycopathol. et Mycol. appl.*, **10**(2), 142–174.
REHM, H., 1896, Ascomyceten (Hysteriaceen und Discomyceten), *Rabenhorst's Kryptogamen-Flora*, **1**, Abt. III.
ROGER, L., 1953, *Phytopathologie des Pays Chauds*, **2**, Paris.
SACCARDO, P., 1882–1931, *Sylloge Fungorum*, Padua.
SAVULESCU, TR. ET RAYSS, T., 1935, Contribution à l'étude de la Mycoflore de Palestine, *Ann. Crypt. exot.*, **8**, 49–87.
STEVENSON, J. A., 1926, Foreign plant diseases, U.S. Dept. Agr., Washington.
Stations fédérales d'essais viticoles, arboricoles et de chimie agricole à Lausanne et à Pully. Rapport d'activitè 1949, 1950, *Annu. agric. Suisse*, **51**(8), 729–861.
THOM, CH. AND RAPER, K. B., 1945, *A Manual of Aspergilli*, Baltimore.
TISDALE, W. H., MELCHERS, L. E. AND CLEMMER, H. J., 1927, Strains of kernel smuts of *Sorghum: Sphacelotheca sorghi* and *S. cruenta*, *J. agric. Res.*, **34**, 825–838.
VELENOVSKY, J., 1934, *Monographia Discomycetum Bohemiae*, pars I et II. Pragae.
VIENNOT-BOURGIN, G., 1949, *Les Champignons Parasites des Plantes Cultivées*, I, II, Paris.
VIENNOT-BOURGIN, G., 1952, Notes de pathologie végétale (année 1951), *Ann. des Epiphyties*, **4**, 527–533.
VIENNOT-BOURGIN, G., 1956, Mildious, Oidiums, Caries, Charbons, Rouilles des plantes de France. Texte et Atlas, *Encyclopédie Mycologique*, **26, 27**, Paris.
VIENNOT-BOURGIN, G., 1958, Contribution à la connaissance des champignons parasites de l'Iran, *Annales des Epiphyties*, No. 2, 97–210.
WINTER, G., 1887, Ascomyceten, Gymnoasceen, Pyrenomyceten, *Rabenhorst's Kryptogamen–Flora*, **2**, I, II.
YARWOOD, C. F., 1935, Heterothallism of sunflower powdery mildew, *Science, N.S.*, **82**, 417–418.

OBSERVATIONS ON THE GROWTH OF *LABYRINTHULA MACROCYSTIS*

M. Aschner and Shulamit Kogan
Technion—Israel Institute of Technology, Haifa

ABSTRACT

The growth pattern of a *Labyrinthula* culture on agar media and changes in this pattern during feeding are described. The feeding reaction consists in the formation of a so-called stream-system which directs widely scattered cells in the netplasmodium over distances of up to 2 cm towards the food. It is concluded that this morphogenetic response is due to an activating impulse which emanates from the point of contact with the food and travels along the filamentous structure of the plasmodium. Observations and experiments in support of this view are described.

INTRODUCTION

The genus *Labyrinthula* is characterized by the formation of a peculiar growth figure, consisting of pointed mobile cells which glide along a fixed network of hyaline filaments. This aggregate of cells and reticular filaments has been called a netplasmodium, and the Labyrinthulales have been placed on account of this formation together with Myxogastrales and Acrasiales in the subclass Mycetozoa of the class Sarcodina (Bessey 1952). The netplasmodium differs, however, in essential points from the plasmodia of typical slime molds, and lately Hollande and Enjumet (1955) observed in *Labyrinthula algeriensis* the occurrence of biflagellated zoospores with typical stigmata. These authors assume, therefore, that the Labyrinthulales are derived from phytoflagellates and probably related to the Chrysomonadinae.

The organization of the netplasmodium is not very well understood and published accounts disagree in the interpretation of the observed details.

Cienkowsky (1867), Dubosc (1921), Dangeard (1932) described the netplasmodium as consisting of cells connected by thin strands of ectoplasma, while Valkanov (1940), Young (1943) and Hollande and Enjumet (1955) claim that the reticulum is not living plasmatic material but a non-living mucus-like excretion of the cells. This last view which seems to be widely accepted today raises several questions. If the cells in the netplasmodium are not connected by plasmatic material but by inert mucus-filaments, what is the principle of morphogenesis in this aggregate and by what means is the remarkable coordination in the movement of cells achieved? This coordination is especially striking during the uptake of food, when widely dispersed cells arrange themselves into a dense pattern resembling a continuous stream system in which they move together towards the source of food. We tried to answer some

Received September 21, 1959.

of these questions by observing the behaviour of a strain of *L. macrocystis* under various conditions on agar media, and the following is an account of our observations and experiments.

MATERIAL AND TECHNIQUE

Details of the isolation of our strain and its cultivation on artificial media have been described in a previous publication (1958). The medium used in the present investigation consisted of agar-agar (strips) 2 g, and 50% sea water 100 ml, to which was added 0.01% Tween 80. We observed that with this addition the *Labyrinthula* cells usually showed little inclination to penetrate into the agar, and remained on the agar surface which facilitates microscopic observation. The food consisted of yeast cells, usually *Rhodotorula pallida*, which were streaked near the border of the plasmodium on the agar surface. Transfers were made either by cutting a small piece of the plasmodium together with the agar and depositing it on a fresh plate in the vicinity of the yeast streak, or by transferring a loopful of material from an invaded yeast streak. Plasmodia could be observed under these conditions for periods of 3 to 4 weeks without transfer.

GROWTH AND DEVELOPMENT OF THE NETPLASMODIUM

If *Labyrinthula* cells together with some food material are deposited on an agar plate, the cells arrange themselves after a lag of 2 to 3 hours into a more or less radial aggregate consisting of ramified hypha-like strands with many connecting side branches. This aggregate somewhat resembles a growing mould mycelium. However, the similarity to the mycelium is only superficial. The strands are formed by individual cells which move singly or in groups along the barely visible net structure, and their elongation is due to multiplication as well as to actual outward migration of these cells towards and beyond the periphery of the aggregate. The net structure is built up by the cells during the process of migration through extrusion of long filaments which stick together and become entangled wherever they meet. It seems as though these filaments serve as a kind of guide rope to the moving cells and designate the path along which their migration must proceed. The stage of expansion continues on the agar plate without any essential change of the pattern of growth as long as food material is available. One loopful of yeast cells sustains the expansion for about five to seven days and if new food is added in sufficient amount the growth may cover finally the whole area of the Petri dishes. Cells multiply during the expansion of the plasmodium, but multiplication obviously does not keep step with the enlargement of the growth area, as is seen by the gradual thinning out of the cell strands along the reticulum. Cells which formerly formed a continuous row are now widely scattered with the hyaline filaments as the only connection between them. In some cases the central parts of the net structure may also disappear so that the central area of the plasmodium will be entirely empty and only the outer border line still retains a somewhat greater number of cells. This state does not last long

and if the plasmodium, after exhaustion of its original food source, does not find a new one, it enters a resting stage through formation of large cyst-like cell aggregates, the so-called sori.

As long as there is no direct contact between the spreading cell mass and a new food source, no effect of the latter on the expansion of the plasmodium can be observed. A noticeable change occurs only after the first cells of the periphery have actually entered the food mass. This change which gradually effects a relatively large area of the plasmodium and changes its morphology, forms a new stage which may be called stage of occupation. We find now that after a few hours of contact with the new food, the former radial strands have been replaced by a large and complicated system of channels which all lead into the new food area. The channels are formed by masses of *Labyrinthula* cells and very much resemble a well developed stream system with its tributaries (Figures 1a and 1b).

This resemblance is heightened by the fact that the *Labyrinthula* cells in these channels are in a continuous gliding movement which is discernible even under the low magnification of the microscope.

The development of the stream system proceeds stepwise and takes several hours (Figures 2–4). Its first indication is an accelerated movement of the cells

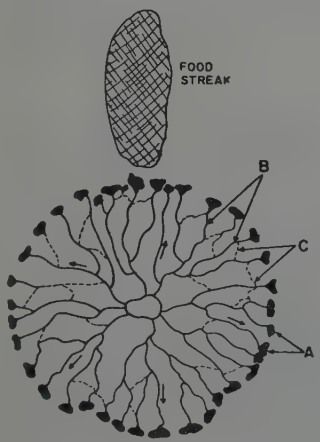


Figure 1a

The plasmodium at a short distance from the food streak. (×25). The regular expansion is not influenced by the proximity of the food source. A—Cell accumulation at the periphery of the plasmodium. B—The radial strands where cells move in an outward direction. C—Anastomosing side connections.

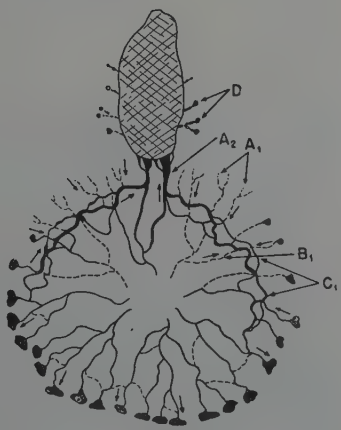


Figure 1b

The same plasmodium after contact with the food mass has been established. The stream system has developed along the side connections and drained cells from some of the former strands (B_1) and from the cell accumulation at the periphery (A_1). At A_2 the main channel leading into the food mass.

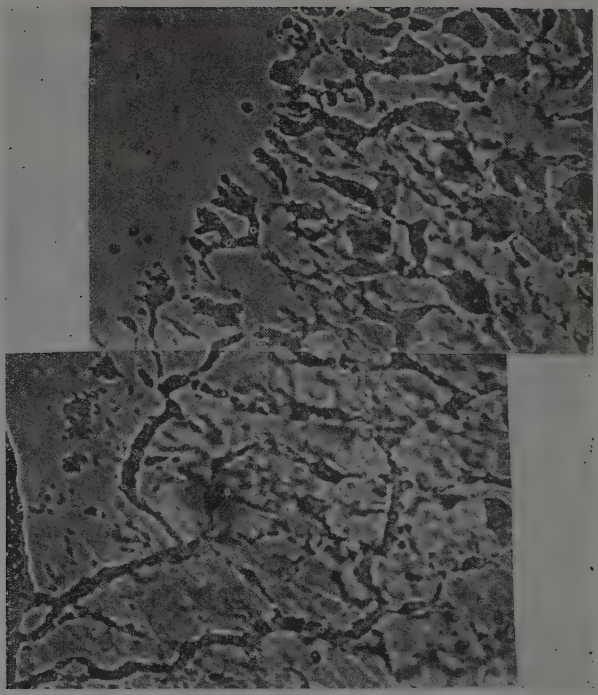


Figure 3a

One hour after contact. The channels of the stream system near the food source are already well marked. (×25).

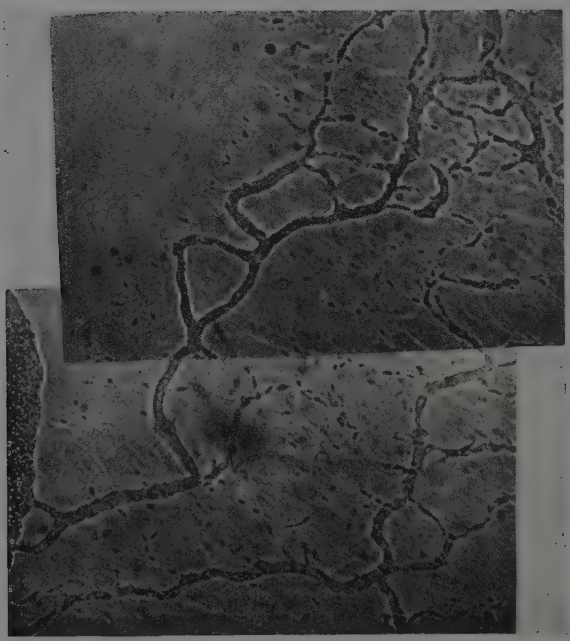


Figure 3b

Two and one half hours after contact, the stream system is rapidly spreading backwards and a relatively large area of the plasmodium been drained of cells. Channels are masses of cells from more distant places. (×25).

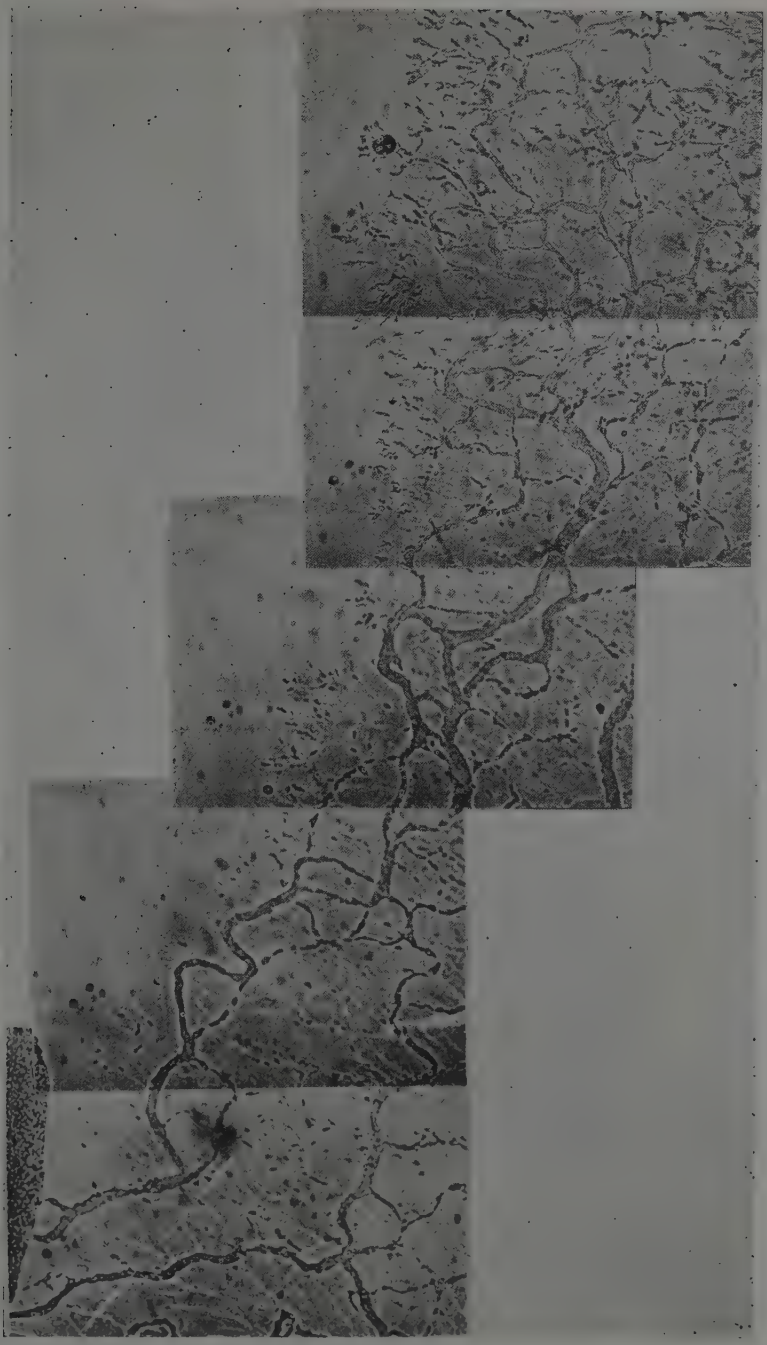
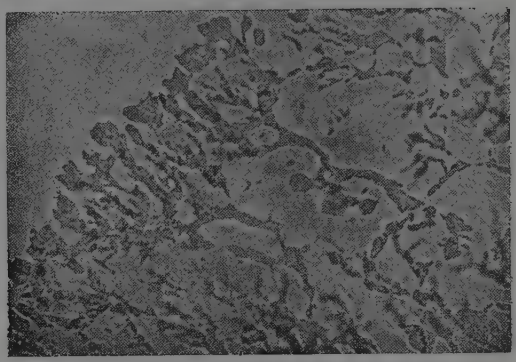


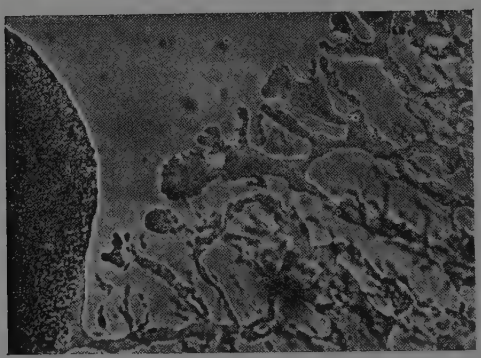
Figure 4
A composite photo of the same plasmodium 4 hours after contact with the food streak. The stream system is at the height of its development and has spread over a distance of about 1.5 cm. Only part of it is depicted. ($\times 20$).

Figure 2

Development of a stream system in the periphery of a large plasmodium after contact with the yeast streak.



(a) The periphery of the plasmodium before the contact. (×25).



(b) About half an hour after contact with the yeast streak. The formation of a stream system has started, but meanwhile it is joined only by a few cells near the food streak. (×25).

which starts in the neighbourhood of the food streak and reaches gradually ever more distant parts of the plasmodium. It is as though an activating impulse is travelling down the strand in a direction opposite the direction of streaming, and induces the cells in this strand to move more energetically towards the food. This presumed impulse effects also the cells in the side branches, and through them reaches those radial strands which have no direct contact with the food. Irrespective of their former movement, cells in these strands now join the strand from which the activation started and enlarge in this way the number of cells travelling in the channel. In consequence of this change of movement the side branches gain in importance. They were formerly rather inconspicuous but now so many cells travel along this new route that they themselves become important arteries, and determine the main direction of migration. The constant attraction of the main stream and the various tributaries that have developed around it drain large areas of the plasmodium from cells and direct them to the new source of food. More distant parts of the plasmodium that are not affected by the activation process continue in their steady radial expansion without any noticeable change of their pattern of migration. After a few hours the invaded food streak becomes transparent, with the contents of most of the yeast cells digested and only their cell-walls remaining. At the same time the population of *Labyrinthula* cells there has become rather dense by the influx of new cells as well as by multiplication of the arrived cells, and emigration sets in. The emigration produces a secondary netplasmodium which expands in the same way as the original one (Figure 1b D).

Velocities of streaming were measured before and after contact with the food. It was found that cells in an expanding plasmodium moved with a velocity of 1.3 microns per minute before contact with a food source was established. Half an hour after contacting the yeast mass, the velocity in the stream system was 90 microns per minute. The effect of activation as measured by the length of the finally formed stream system may spread as far as 2 cm.

EXPERIMENTAL INTERFERENCE WITH THE STREAM SYSTEM

In order to find out whether the activating stimulus is travelling by diffusion through the agar medium or by some other route, the following experiments were carried out: Main strands leading into the food stream were disrupted by passing a blunt glass needle through the streaming cell mass without cutting the agar surface. The cells in those parts of the strands which were still connected to the food continued their way and entered the food mass while the others accumulated at the disruption as though it was an unsurmountable barrier. In cases where a detour through an anastomosing side branch was possible this way was chosen instead of the shorter, direct route.

In another experiment a short section at the periphery of an expanding plasmodium was separated from the rest of this body by the same method. In this case the inter-

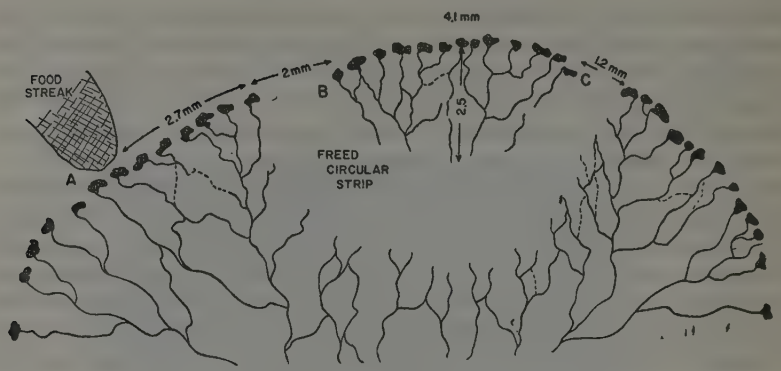


Figure 5a

The situation at the interrupted periphery of the plasmodium before contact with the yeast streak was established. (A schematic drawing).

ruption consisted of a narrow semicircular strip which was entirely free from cells as well as net filaments, while the agar surface itself was not cut or visibly scratched. The length of the separated section was 4.1 mm, the width of the circular strip 1.2–2 mm. A food streak was then deposited near the separated piece in such a way as to come in contact with the periphery of the main plasmodium only (Figure 5a).

The distance between the place of contact A and the nearest point of the separated section B, was 2.7 mm.

A stream system developed in the main plasmodium in the usual way and finally even rather distant cells were travelling in the channels of this system towards the food source. The cells in the separated section, although much nearer to the food, were not included in this stream system and continued their radial outward migration for two days without any change of direction or velocity. After this period the cells of the separated sector and of the main plasmodium came again together by the normal expansion of the periphery. The point of the new contact was at C, i.e. at a greater distance from the food streak than B. Nevertheless cells around point C now became activated and finally part of the stream system, while cells around point B (although much nearer to the source of food) continued their outward movement without any indication of influence by the food streak (Figure 5b).

DISCUSSION

It has been demonstrated during this study that the movement of *Labyrinthula* cells on the agar medium is not modified by the vicinity of cellular food so long as the plasmodium is not actually in contact with it. If, however, some part of the plasmodium has reached the food source, large numbers of cells arrange themselves

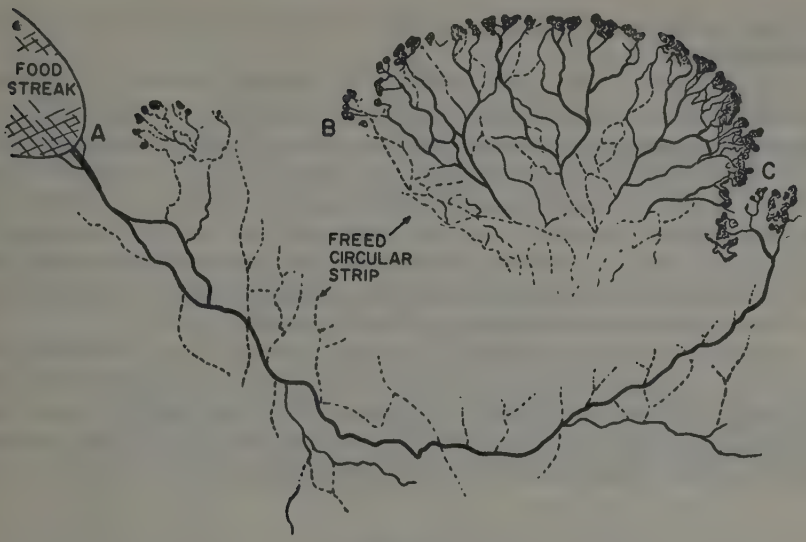


Figure 5b

The situation at the interrupted periphery two days after contact with the food. The stream system has developed only in that part of the plasmodium which is connected with the food mass by the continuous net structure. Movement of cells towards the food occurs, irrespective of their position, only through the stream system. (Drawn from a composite photo. ×10).

into typical stream systems and move towards this place as though attracted or activated by some agent emanating from it. This property makes not only for efficient exploitation of the food source, but enables the plasmodium to attack a prospective host plant with a large number of cells. Garrett (1956) in dealing with root infections by soil fungi postulated that for many of these organisms successful invasion of the host plant is possible only if their concentration in the soil or, as Garrett calls it, "the infection potential" is high. The activation mechanism of the *Labyrinthula* plasmodium obviously raises the infection potential of this organism and this is undoubtedly an important ecological advantage for a plant parasite.

It is not known in which way the supposed impulse or agent responsible for the formation of the stream system is transmitted from cell to cell. A break in the net structure of the plasmodium or in the stream system itself is not traversed except by actual growth, and cells in the vicinity of a food source but separated from it by such a break remain apparently inactivated. It is therefore very unlikely that the morphogenetic effect observed is due to the diffusion gradient of a water soluble substance emanating from the food source and spreading through the agar medium. The observed facts rather indicate the net structure of the plasmodium as the medium in or along which the activating impulse proceeds. However, the evidence is not

refficient to exclude definitely participation of a diffusion gradient as one of the directing factors.

Accordingly two different interpretations are possible. Either a disturbance actually travels along the filaments and thereby successively activates all the cells adhering to them, or each cell after activation acquires the faculty to activate cells in its neighbourhood which now act as new centres of activation and attraction. As the cells of *Labyrinthula* move preferably along the net structure, the activation impulse would then appear to travel the same route. With this latter assumption, however, it is difficult to explain why this process does not continue until all the cels of the plasmodium are activated and directed towards the food. As already stated, we did not observe the activation to reach further than about 2 cm.

The spread of activation along a fixed structure instead of a highly labile diffusion gradient in water might be an adaptation of the *Labyrinthula* plasmodium to the conditions prevailing in its biotop, the ocean and other large bodies of water. The constant and irregular motion of the water in these places prevents any directing effect a diffusion gradient might have in less turbulent places.

REFERENCES

ASCHNER, M., 1958, Isolation of *Labyrinthula macrocystis* from soil, *Bull. Res. Counc. of Israel*, **6D**, 174.

BESSEY, E. A., 1952, *Morphology and Taxonomy of Fungi*, The Blakiston Co., Philadelphia.

CIENKOWSKY, L., 1867, Ueber den Bau und die Entwicklung der Labyrinthuleen, *Arch. mikr. Anat.*, **3**, 274.

DANGEARD, P. A., 1932, Observations sur la famille des Labyrinthulées et sur quelques autres parasites des Cladophora, *Botaniste*, **24**, 217.

DUBOSQ, O., 1921, *Labyrinthomyxa sauvageaui* n.g., n. sp., Proteomyxée parasite de *Laminaria lejolisii* Sauv., *C. R. Soc. Biol.*, **84**, 27.

GARRETT, S. D., 1956, *Biology of Root-infecting Fungi*, University Press, Cambridge.

HOLLANDE, A. ET ENJUMET, M., 1955, Sur l'évolution et la systématique des Labyrinthulidae, *Ann. des Sc. nat., Zool.*, **17**, 357.

VALKANOV, A., 1940, Die Heliozoen und Proteomyxien, *Arch. f. Protistenk.*, **93**, 225.

YOUNG, E. L., 1943, Studies on *Labyrinthula*. The etiologic agent of the wasting disease of eel-grass, *Am. J. Bot.*, **30**, 586.

PHYSIOLOGIC RACES OF OAT CROWN RUST IDENTIFIED IN ISRAEL IN 1956–59

I. WAHL

Faculty of Agriculture, The Hebrew University, Rehovot

ABSTRACT

Twenty-two physiologic races of *Puccinia coronata avenae* were isolated from 115 collections secured from oats in Israel in 1956–59. Nine of these races have never been described hitherto. Six of the new races are virulent on Santa Fe but innocuous on Landhafer. The preponderant majority of isolates and races parasitize Bond and Santa Fe, while Landhafer, too, is vulnerable to 66% of the isolates.

In previous reports (Wahl and Schreiter 1953, Wahl 1958) physiologic races of oat crown rust most prevalent in Israel in 1952–56 have been described. Attention was drawn to the fact that the identified races are virulent on Landhafer and Santa Fe, both varieties frequently incorporated in oat breeding programs as sources of resistance to *Puccinia coronata* Corda var. *avenae* Fraser et Ledington.

On the basis of our findings a prediction was made that identical or similar races are likely to appear also in other oat-cultivating regions, and therefore breeders have been advised not to rely too heavily on the crown rust resistance factors afforded by Landhafer or Santa Fe (Wahl 1958). Recent publications from the U.S. prove that speculations became a reality sooner than anticipated. Physiologic races capable of attacking Landhafer and Santa Fe, the so-called "Landhafer races" (Simons et al. 1957), were discovered in the U.S. and Canada and caused considerable concern. Consequently, Simons et al. (1959) concluded that "extensive testing failed to reveal any hexaploid varieties with adequate seedling resistance" to the races concerned.

The present paper summarizes the results of the research on physiologic specialization of oat crown rust conducted in Israel in 1956–59. A total of 190 collections was investigated; 115 collections were secured from cultivated and wild oats, and the remainder from *Rhamnus palaestina* Boiss. The data presented here pertain to the material isolated from oats.

In our race identification tests, unipustular isolates were employed, each collection being credited with one isolate. Spores derived from a single uredium were increased

Received October 21, 1959.

on seedlings of the very susceptible variety Fulghum, and subsequently used for inoculation of seedlings of 10 standard differential oat varieties. The inoculation technique and the incubation procedure were essentially the same as recommended by Stakman et al. (1944). Races were identified with the aid of determination keys (Simons 1954, 1955, 1957; Simons and Michel 1958) on the basis of the diagnostic reactions produced on the differential hosts.

Nine isolates constitute races never described heretofore. The diagnostic reactions incurred by them on seedlings of the differential varieties are given in Table I. Numbers have been assigned to them by Dr. M. D. Simons, and they are indicated in the table.

TABLE I

Reaction of standard differential oat varieties in the seedling stage to new races first collected and identified in Israel in 1956–59

Race No.	Anthony	Victoria	Appler	Bond	Landhafer	Santa Fe	Ukraine	Trispernia	Bondvic	Saia
311	S	R	S	S	S	S	S	R	S	I
312	R	R	R	S	R	S	S	R	S	I
313	R	S	S	S	R	S	S	S	S	I
314	S	R	S	S	S	S	R	R	S	I
315	S	R	S	R	R	S	R	R	R	I
316	S	S	S	S	R	S	S	S	S	I
317	Int	R	S	R	R	S	R	R	S	I
318	S	R	R	R	R	R	S	S	S	I
319	S	S	S	R	R	S	S	R	S	I

* Letters indicate the following reaction classes (infection types are those of Stakman et al. (1944):

R — stands for resistant reaction class and embraces 1 and 2 infection types;
S — denotes susceptible host reactions and includes infection types 3 and 4;
I — designates immunity and includes 0 and 0 infection types;
Int — indicates that the reaction of the variety cannot be clearly classified as resistant or susceptible.

The tabulated data lead to the conclusion that from the breeder's standpoint 8 of the newly discovered races can be combined into 2 composite groups, one complex unit consisting of races virulent on both Landhafer and Santa Fe (races 311, 314) while the second unit embraces races virulent on Santa Fe but harmless on Landhafer (races 312, 313, 315, 316, 317, 319). Reactions exhibited by Victoria seedlings are not stable and vary readily with the environmental conditions; hence they can hardly be used as dependable criteria for grouping of races. Reactions displayed on Landhafer, although more reliable than those on Victoria, are not always clearly defined. Large uredopustules signifying susceptibility are sometimes surrounded by chlorotic areas tending to become sandy-yellow.

The remaining 106 isolates furnished from oats are distributed among 13 races in order of frequency indicated in Table II.

The closely related races 276 and 264, both parasitic on Landhafer, Santa Fe, Bond, Anthony, Appler, Bondvic, Ukraine and Trispernia, and most prevalent in 1956–59, were also common here in previous years (Wahl and Schreiter 1953, Wahl 1958). The latter race, originally detected and identified in Israel (Wahl 1958), appeared in the U.S. in 1954 (Simons 1955) and reached epiphytotic proportions in Florida in 1957 (Simons et al. 1957). During this year, race 264 was isolated in 20 of 31 States in the United States in which collections were made (Simons and Michel 1958, Table II). Since race 264 was recognized as a potential menace to oat cultivation, a collection of oats consisting of about 4,800 entries has been tested for resistance to this race at Isabela, Puerto Rico.

TABLE II

Identity and prevalence of physiologic races of oat crown rust isolated from uredial collections in 1956–59

Physiologic race	Number of times each race was found in uredial collections
Group 276–264–263	43
Group 202–203	14
286	13
270	12
Group 216–217*	9
277	6
201	2
209	1
210	1
211	1
213	2
224	1
279	1

* The race group 216–217 was absent in uredial collections in 1958–59.

Race 202–203 complex, the second most common in the investigations, pathogenic on Bond, ranked as the most prevalent in the U.S. from 1951 to 1956. It was relegated there to third place in 1957 (Simons and Michel 1958). The Victoria-attacking race 216–217 complex was unknown in Israel prior to 1956, and disappeared again in 1958–59. Race 216 gained in importance in the U.S. in 1957 accounting for 40% of the total isolates (Simons and Michel 1958).

Races 286, 270 and 277 resemble races 276 and 264 in their ability to attack both Landhafer and Santa Fe.

In the reported seedling tests the standard set of 10 differential oat varieties was supplemented by several additional varieties featured by high crown rust resistance in the uniform rust observation field nurseries. Seedlings of selections of the Landhafer × (Mindo × Hajira-Joanette) crosses, like Minn. II-47–12 and Minn. II-47–17 exhibited reactions of moderate to high resistance to all physiologic races involved.

Seedlings of the variety Floriland (C. I. 6588) deriving their resistance from Bond and Landhafer (Chapman 1952), consistently displayed resistance to the following races virulent on Bond but harmless on Landhafer: 201, 202–203, 209, 210, 213, 216–217, 224, and 279. Obviously, resistance transferred from Landhafer dominates over the factors conditioning suspectibility inherited by Floriland from Bond. On the other hand, races innocuous on Bond but pathogenic on Landhafer, such as 270, 277, and 286 have so far been virulent on the majority of Floriland seedlings, however, in some instances seedlings resistant primarily to race 286 have also been encountered. These data should be considered as preliminary and inconclusive. Further research on the genetic nature of resistance endowed by Floriland is in progress.

Particularly noteworthy seems to be the fact that some isolates of races 264 and 276, capable of attacking both Landhafer and Bond, parasitize Floriland vigorously while others proved to be harmless on Floriland. Presumably, resistance displayed by Floriland to the isolates mentioned is governed by several genes inherited from both parents. These results support the hypothesis of Simons et al. (1957) postulating that the combination of available genes may confer higher resistance to the "Landhafer races", due to a complementary effect, than the same genes would furnish alone. In the case of oat stem rust, Welsh (1937) obtained hybrids resistant to races 6 and 8 "through to the medium of transgressive segregation, as neither parent is resistant to these two races".

Analysis of results summarized in Tables I and II reveals distinct heterogeneity in the crown rust races population. Yet in the diversity of components, some common features can be readily distinguished. Out of the 115 isolates listed in both foregoing tables, 76 (66%) parasitize Landhafer, 80 (69.5%) attack Bond, and 83 (72.%) are pathogenic on Santa Fe. Twenty two races representing the 115 isolates comprise 6 (27%) races, or groups of races virulent on Landhafer, 15 (68%) pathogenic on Bond, while Santa Fe is vulnerable to 12 races constituting 54.5% of the total. The spectrum of physiologic races outstanding for their virulence on some very importat sources of oat crown rust resistance is most significant. The results obtained could not be affected, obviously, by the selective action of the host, since the majority of the investigated isolates was supplied from varieties susceptible to all races involved.

An attempt has been made to assess the degree of agreement between the data provided by races identification tests and the records on the severity of crown rust

incidence developed on Landhafer, Santa Fe, Bond and their derivatives in the uniform field nurseries. The uniform oat rust observation field nurseries were planted over the years 1956–59 in a dozen or more localities from the Upper Galilee in the north to the Negev in the south (about 30 km south of Beersheba). Bond and its hybrids have always been severely affected by crown rust; the same is true of Santa Fe, while Landhafer was considerably less damaged by the disease than could be expected from the percentage prevalence of the "Landhafer races" computed on the basis of the greenhouse studies. Landhafer, evidently, possesses a certain degree of field resistance as observed by Simons and Michel (1958) in the United States.

Varieties rated as resistant in the fields in previous years, such as Acre, Rehovot, Minn. II-47–12, and Minn. II-47–17 (Wahl 1958) have retained their resistance in 1956–59, the latter 2 varieties have been also resistant in the seedling stage to all the races concerned. Saia has been thus far practically immune from all our crown rust races both in the field and in the greenhouse. This variety attained great importance in oat cultivation in Israel. Due to the kindness of Dr. H. C. Murphy we have been given an opportunity to test our selections of Minn. II-47–12, Minn. II-47–17, and Rehovot in the special crown rust race 264 nursery at Isabela, Puerto Rico. All our entries proved to be suspectible there (Dr. Murphy, personal communication). Disagreement in rust performance here and abroad may be attributed either to the possible existence of more virulent and aggressive subraces or biotypes in Puerto Rico or to a specific influence of the plant environment. The fact that the varieties listed have been consistently resistant to race 264 in Israel in different regions, and under diverse climatic conditions makes the first explanation more plausible.

ACKNOWLEDGEMENTS

The writer wishes to acknowledge his appreciation to Drs. H. C. Murphy and M. D. Simons for their manifold assistance and constant collaboration throughout the entire period of this investigation. Thanks are due to Dr. W. H. Chapman for providing a liberal supply of seed of the Floriland variety.

REFERENCES

Chapman, W. H., 1952, Floriland oats, *University of Florida Agr. Exp. Sta. Circular S*-53, 8 pp.

Simons, M. D., 1954, Physiologic races of crown rust of oats identified in 1953, *U.S. Dept. Agr. Plant Disease Reptr.*, **38**, 649–652.

Simons, M. D., 1955, Physiologic races of crown rust of oats identified in 1954, *U.S. Dept. Agr. Plant Disease Reptr.*, **39**, 949–955.

Simons, M. D., 1957, Physiologic races of crown rust of oats identified in 1956–57, *U.S. Dept. Agr. Plant Disease Reptr.*, **41**, 970–972.

SIMONS, M. D., LUKE, H. H., CHAPMAN, W. H., MURPHY, H. C., WALLACE, A. T. AND FREY, K. J., 1957, Further observations on races of crown rust attacking the oat varieties Landhafer and Santa Fe, *U.S. Dept. Agr. Plant Disease Reptr.*, **41**, 964–969.

SIMONS, M. D. AND MICHEL, L. J., 1958, Physiologic races of crown rust of oats identified in 1957, *U.S. Dept. Agr. Plant Disease Reptr.*, **42**, 1946–1949.

SIMONS, M. D., SADANAGA, K. AND MURPHY, H. C., 1959, Inheritance of resistance of strains of diploid and tetraploid species of oats to races of the crown rust fungus, *Phytopathology*, **49**, 257–259.

STAKMAN, E. C., LEVINE, M. N. AND LOEGERING, W. Q., 1944, Identification of physiologic races of *Puccinia graminis tritici*, *U.S. Dept. Agr. Bur. Ent. Pl. Quar. E*-617, 27 pp.

WAHL, I., 1958, Studies on crown rust and stem rust on oats in Israel, *Bull. Res. Counc. of Israel*, **6D**, 145–166.

WAHL, I. AND SCHREITER, S., 1953, A highly virulent physiologic race of crown rust on oats in Israel, *Bull. Res. Counc. of Israel*, **3**, 256–257.

WELSH, J. N., 1937, The synthetic production of oat varieties resistant to race 6 and certain other physiologic races of oat stem rust, *Canadian J. Res. C*, **15**, 58–69.

FURTHER STUDIES IN ATMOSPHERIC POLLEN IN JERUSALEM*

NAOMI FEINBRUN, ANNA RAHAT AND J. TAS

Department of Botany of the Hebrew University and the Allergy Clinic, Department of Dermalotogy and Venereology, Hadassah University Hospital, Jerusalem

ABSTRACT

A second report on airborne pollen in Jerusalem (see Parag et al. 1957) from the end of October 1955 to the beginning of October 1956. The pollen amounts were calculated per 1 day and 1 cm².

The results were similar to those previously reported with regard to the main pollen contributors and the shape of pollen curves. The decline in pollen amounts was apparently due to the lower rainfall in February and March, 1956.

A report was recently published on airborne pollen collected in Jerusalem in 1953-54 (Parag et al. 1957). It was considered advisable to make further observations for at least one additional year, for annual climatic variation in Jerusalem is considerable. The results of pollen catches during the period between October 25, 1955 and October 5, 1956 are now reported. The fact that a period of about three weeks in October is not accounted for is a drawback as far as autumn- flowering trees are concerned.

The method of pollen catches was as described in 1957. The same standard collector was set up and the slides were exposed every 48 hours. The numbers of pollen grains collected were calculated per one day and 1 cm².

Two stations were used: Station A, on the roof of the Hebrew University-Hadassah-Medical School, was adjacent to the site of station A of the previous investigation. This is in the city centre and very near the Old City of Jerusalem. Station B, on the roof of a two-storey building in the Rassco quarter in the western outskirts of Jerusalem, was about 1 km south of station B of the previous investigation.

RESULTS

The daily and monthly distribution of pollen catches from various pollen contributors are shown in Table I and in Figures 1–2.

A. Main pollen contributors

These were as in the previous paper with minor changes.

1. *Cupressus. C. sempervirens* is the most common species. *C. macrocarpa* and *C. arizonica* grow occasionally. *Cupressus* pollen occurred from January to the end

* This investigation has been supported by a grant from the Hadassah Medical Organisation.

Received September 4, 1959.

TABLE I

Monthly and annual totuls of pollen grains referred to 1 cm²

A = station A B = station B

Pollen contributor	Station	X 1955	XI	XII	I 1956	II	III	IV	V	VI	VII	VIII	IX	1.X–5.X	Annual total
1. *Cupressus*	A				3.5	575	31	7.5	–						617
	B				43.5	1089	54	12.4	0.4						1149.3
2. *Pinus halepensis*	A		0.4	0.4	0.4	2.2	393	16.4	11.5	2.6					426.9
	B		0.4	–	–	6.2	921	85	14.6	3.1					1030.3
3. *Morus*	A							54.6							54.6
	B							6.7							6.7
4. *Casuarina*	A	2.6	0.8	7.5	–										10.9
	B	2.2	0.4	3.1	3.5										9.2
5. *Olea europaea*	A							15	88	2.2					105.2
	B							4.4	177	7.1					188.5
6. *Ceratonia siliqua*	A		–												–
	B		0.4												0.4
7. *Poterium spinosum*	A				5.3	66.6	15.5	1.7							89.1
	B				2.2	41.7	8.0	–							51.9
8. Gramineae	A				–	4.8	7.5	118.0	84	2.2	4	2.6			223.5
	B				0.4	0.4	4.8	85.3	51.5	3.1	1.3	0.8			147.6
9. *Quercus calliprinos*	A							7.1	8.4						15.5
	B							8	7.5						15.5
10. *Eucalyptus*	A							0.4							0.4
	B							1.3							1.3
11. *Ailanthus glandulosa*	A							0.8							0.8
	B							8.0							8.0
12. *Prunus*	A							1.7							1.7
	B							2.2							2.2
13. *Parietaria judaica*	A		1.7	–		0.8		0.4							2.9
	B		0.8	0.4		0.8		1.3		0.4					3.7
14. *Chenopodium*	A	–						1.7	32.4	65.7	5.3				105.1
	B	1.7						1.3	8.0	8.0	1.3				20.3
15. *Amaranthus*	A		3.1			0.8									3.9
	B		–			0.4									0.4
16. *Polygonum equisetiforme*	A	0.4	0.4	–				0.8							1.6
	B		0.8	0.4				–	1.3	1.7	1.3				5.5
17. *Hyoscyamus aureus*	A								–						–
	B								0.4						0.4
18. Cruciferae	A							2.6	1.3						3.9
	B							71.5	0.4						71.9
19. Umbelliferae	A							8	16	0.8	0.4				22.2
	B							0.8	8.4	1.7	–				10.9
20. Labiatae	A								–						–
	B								0.4						0.4
21. Compositae	A	–	0.4	0.4			–	3.1	3.1						7.0
	B	0.4	–	–			1.3	–	3.5						5.2
22. *Anemone coronaria*	A							0.4							0.4
	B							0.4							0.4
23. *Plantago*	A		0.4					1.7							2.1
	B		–					2.6							2.6
24. *Lilium*	A									0.4					0.4
	B									–					–
25. Unidentified	A	0.4	0.8	0.8	1.3	1.3	3.1	8.4	6.4	3.1		0.4	0.8		26.8
	B	–	–	–	1.7	0.4	2.2	9.7	16.4	3.5		–	–		33.9

of April, with peak amounts in February in both stations. The annual totals were lower than in 1953.

2. *Pinus*. The common species is *P. halepensis*. Pine pollen was registered from November to June with a high peak in March. The flowering time is in March and April.

3. *Grasses*. As is usual, grass pollen was found in comparatively large quantities. Catches were registered from January to August, the highest amounts occurring in April and May. A similar peak was noted in the previous report. The catches of Station A were higher than those of Station B, the reverse of the position in 1953.

4. *Olea europaea*. Olive pollen was registered from April to June. Only scattered grains appeared in the first and last months, but there was a sudden peak in May. In 1953 no olive pollen was found in April, but the May catches were perceptibly higher.

5. *Poterium spinosum*. Pollen of this dwarf shrub, which is characteristic of the Jerusalem landscape, was found from the middle of January to the very end of March. The maximum was in the second half of February whilst in 1954 the maximum was in March.

6. *Morus nigra*. As in the previous report, pollen of *Morus* was prominent in Station A and very slight in Station B. *Morus* trees grow in a small public garden adjacent to the Medical School. The time of collection was in the first half of April, and the total was much lower than in 1953.

B. Plants which contributed small pollen amounts

(*a*) *Trees*

1. *Ceratonia siliqua*. Only a few pollen grains were found at Station B in November, and none at Station A. This again confirms the opinion that the carob tree is not pollinated by wind or air currents. However, it is possible that some pollen could have been collected during October, both in 1955 and 1956.

2. *Casuarina*. Small quantities of *Casuarina* pollen were found from October to January. Here again, the more complete data in October may have increased the registered amounts.

3. *Quercus calliprinos*. Somewhat larger pollen catches were registered than in the previous report. In each of the two stations there was an annual total of 15.5 pollen grains per day/1 cm^2 the catches being scattered from the beginning of April to the end of May. This period corresponds to the flowering time of this oak, the only species in Jerusalem.

4. *Eucalyptus*. Small quantities were registered in April at both stations. In 1953 somewhat higher amounts were found at Station A from May to August.

No pollen of *Pistacia* and of *Schinus molle* was found, although recorded in the previous paper. There were catches of the pollen of two trees not previously recorded: *Ailanthus glandulosa* and *Prunus* sp. It should be mentioned that *Ailanthus* pollen has proved allergenic in patients (Tas 1956). There is a large plantation of *Prunus* trees, mainly plums, in the valley below Station B.

(*b*) *Shrubs and Herbs*

1. *Cruciferae*. Pollen identified only as to family was found in appreciable amounts in April at Station B. There are large cabbage plots in the nearby valley. A common plant of the *Cruciferae* family, growing in abundance in April and May, is *Hirschfeldia incana*, a ruderal annual confined mainly to roadsides. It flowers later than most crucifers of the wild flora, which mainly blossom in February and March.

2. *Umbelliferae*. Pollen of this family was registered from April to July. Umbelliferous plants flower rather late in the season. Among those common around Jerusalem in late spring and early summer are: *Daucus maximus*, *Colladonia anisoptera*, *Peucedanum spreitzenhoferi* and *Foeniculum vulgare*. The last species, the commonnest among the plants mentioned, grows profusely on gravelly and disturbed soil around the town.

3. *Compositae*. Pollen from this family apparently belonged to several species. Very small catches were registered from October to December and somewhat larger ones in the main flowering season from March to May. Two common species, *Inula viscosa* and *Varthemia iphionoides*, both emitting a heavy odour, blossom in autumn near Jerusalem.

4. *Labiatae*. Some pollen of this mainly entomophilous family was collected in May at Station B. *Salvia judaica* and *Phlomis viscosa* are representative plants growing near the site in considerable amounts and flowering in May.

5. *Parietaria judaica*. Pollen of this perennial herb, very common on shady walls, was found in the form of scattered grains from November to June. In 1953 it was only found in May. Alemany Vall (1956 a,b) found many cases of allergy to pollen of this species in Barcelona.

6. *Hyoscyamus aureus*. Pollen of *Hyoscyamus* was found only in May, whereas in 1953 it was registered throughout the summer.

7. *Chenopodium*. Pollen from apparently more than one species of this ruderal genus was found from April to July in quantities much exceeding those of 1953. The maximum was in May and June.Two *Chenopodium* species are common in Jerusalem: *Chenopodium vulvaria* and *Chenopodium murale*. *Atriplex roseus*, of the same family is a summer ruderal very common in waste places and near houses.

8. *Amaranthaceae*. Only a few pollen grains were recorded in November and even fewer in February.

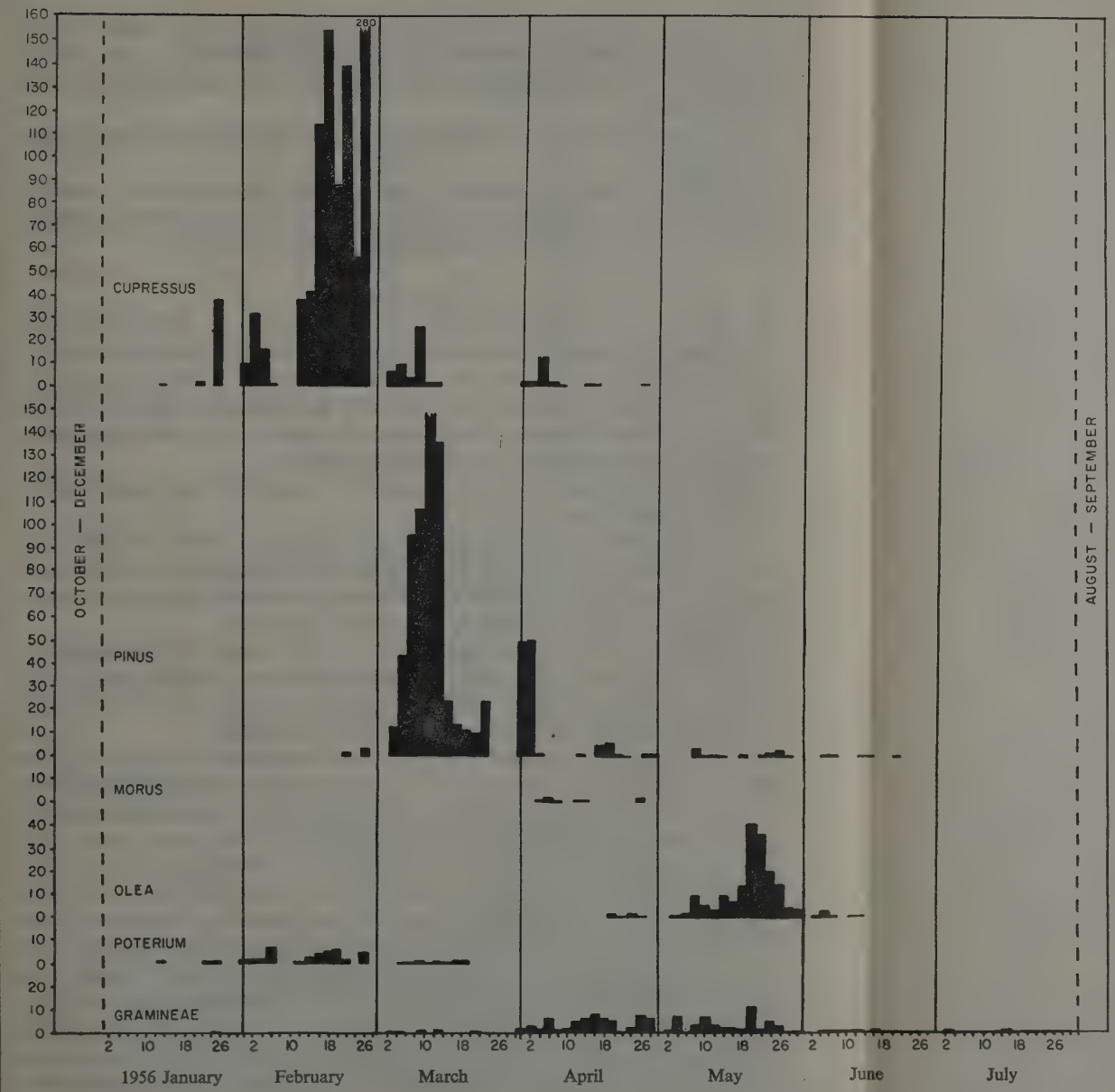
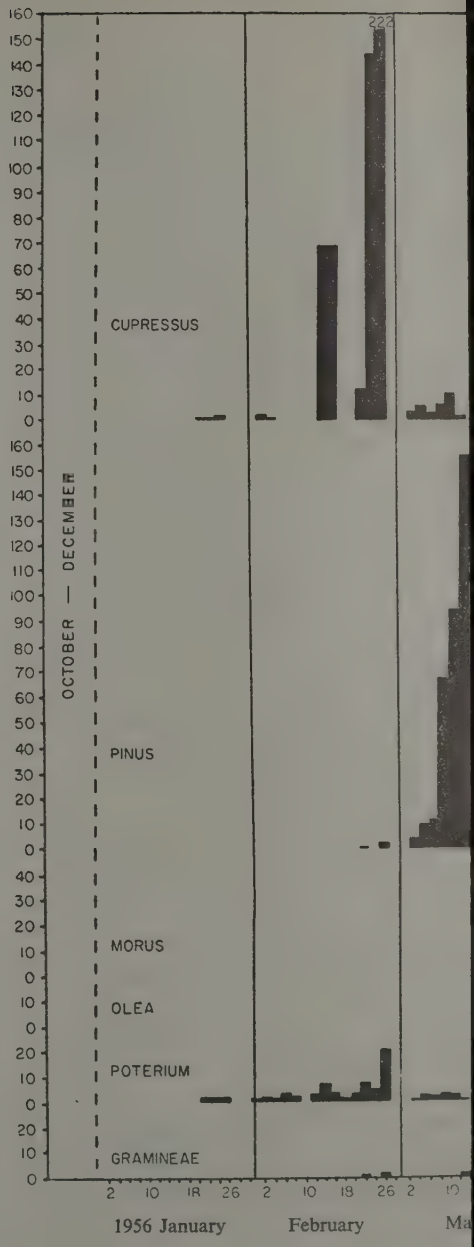


Figure 1

Graph of pollen catches at Station A once in two days during the period 25.X.1955—5.X.1956 calculated for day/cm².



Graph of pollen catches at Station B once

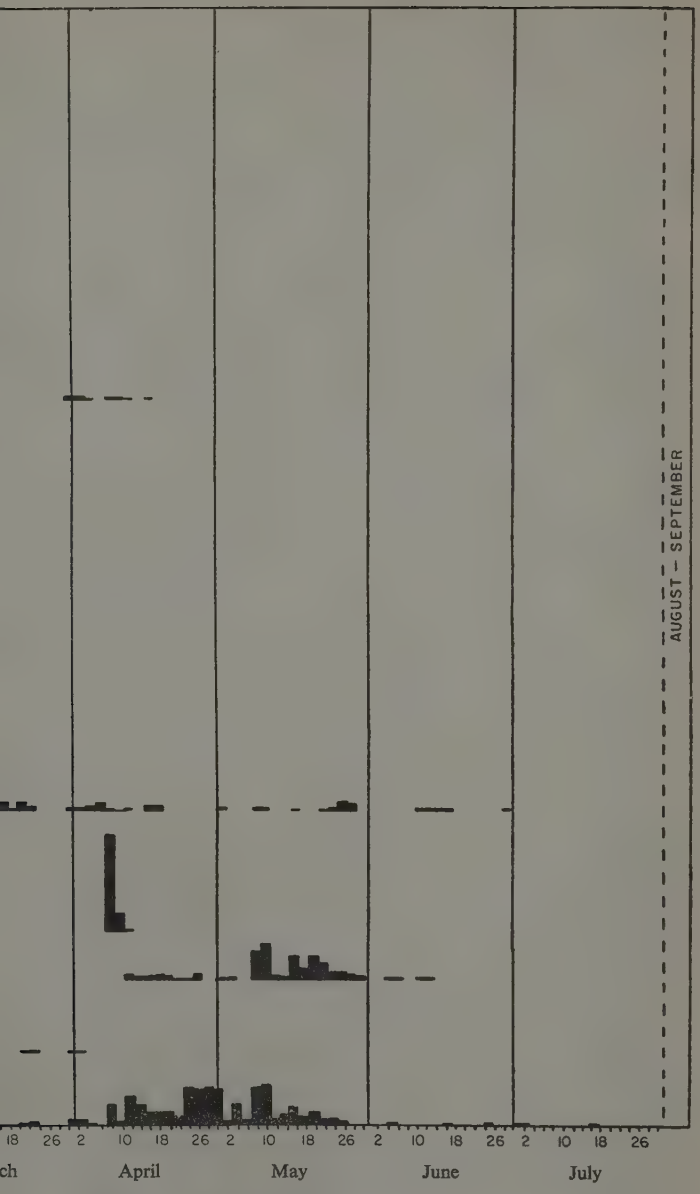


Figure 2

two days during the period 25.X.1955—5.X.1956 calculated for day/cm².

9. *Polygonum equisetiforme* is a common ruderal plant found in Jerusalem. *Polygonum* pollen was found from October to December and from April to July, that is, from the end of the flowering season in 1955 through the main part of the 1956 flowering season.

The flowering period of *P. equisetiforme* is very long, being interrupted during the cold months.

10. The pollen catches of *Anemone coronaria*, *Lilium* (apparently from *L. candidum* grown for ornament in Jerusalem) and *Plantago* sp. seem to be accidental. Unidentified pollens were found in very small amounts throughout the year.

DISCUSSION

The period of observation covered by this report, October 25, 1955 to October 5, 1956, comprises the whole of an annual vegetative cycle. This period has an advantage over the previous one (from March 1953 until the end of March 1954) in that the latter comprised the end of one season and the beginning of the other, i.e. two incomplete flowering seasons. This difference in periods of observation, however, makes direct comparison of results somewhat difficult.

Nevertheless, the general picture remained the same, with only minor changes. (See Table I and Figures 1-2).

The main pollen contributors remained *Cupressus*, *Pinus*, grasses and *Olea europaea*. Some Chenopods, *Poterium spinosum* and *Morus* constituted the second main group of pollen sources. Chenopods pollen appeared in considerably higher amounts than in the previous investigation, especially in Station A.

A comparison of the annual total catches from the main pollen contributors in both reports is given in Table II. Since the month March, in which large pollen amounts are collected, appears twice in the first report (1953 and 1954), the March 1954 totals were deducted to make the data more comparable.

Table II shows that the pollen amounts collected in 1955-56 were much lower than those of 1953-54. Since the method of registration adopted in both reports was identical, the differences are probably due to the changed meteorological conditions.

Comparison of rainfall amounts is given in Table III*. The annual rainfall totals do not help explain the decline in pollen amounts in 1956. However, when one compares the separate and combined rainfall of February and March during the years concerned, it is seen that February 1956 was extremely dry (and warm), and even the combined rainfall of February and March was much lower in 1956 than in 1953. In February 1956 ten days of low humidity were registered in Jerusalem, against five similar days in February 1953. Since the flowering season of all trees listed in Table II is confined mainly to the months of February, March and April, the assumption seems justified that the amount of pollen liberated by these trees mainly depends on rainfall and humidity of the air during February and March.

* The data were kindly supplied by Dr. J. Lorch and by the Israel Meteorological Service, Tel-Aviv.

TABLE II

Comparison of the annual total of pollen grains referred to 1 cm^2

Pollen contributor	Station	March 1953 to Febr. 1954	Oct. 1955 to Oct. 1956
Cupressus	A	1834	617
	B	1404	1149
Pinus	A	1071	427
	B	817	1030
Morus nigra	A	174	55
	B	6	7
Casuarina	A	25	11
	B	16	9
Olea europaea	A	212	105
	B	265	188
Ceratonia siliqua	A	6	—
	B	9	0.4
Poterium spinosum	A	60	89
	B	57	60
Gramineae	A	152	223
	B	304	148

TABLE III

Rainfall in 1952–53, 1953–54 *and* 1955–56

a. Monthly amounts in mm (Rainy days in parentheses)

	X	XI	XII	I	II	III	IV	V	Total
1952–53	6	16	19	95	136	233	2	—	497
	(2)	(4)	(7)	(10)	(12)	(19)	(2)		
1953–54	drops	167	135	38	183	20	22		585
		(12)	(13)	(9)	(13)	(6)	(4)		
1955–56	1	156	70	134	38	151	4		555
	(3)	(10)	(11)	(13)	(9)	(13)	(5)		
Average of many years									480

b. Rainfall during main flowering season of trees

	II	III	II + III	I + II + III	Total
1953	136	223	359	454	497
1954	183	20	203	261	585
1956	38	151	189	323	555

The difference in pollen amounts was less prominent with the grasses.

Kessler (1953, 1954, 1958) reported a five year pollen survey in Tel Aviv, situated on the coast. The Tel Aviv vegetation in general is quite different from that of Jerusalem, and this includes the wild grasses. It is therefore noteworthy that the pollen curves of both localities are very similar. Grass pollen is the most important of the pollen allergens, and it should be mentioned that *Cynodon dactylon*, the main allergenic grass of Israel, is grown in lawns throughout the country.

REFERENCES

ALEMANY VALL, R., 1956a, Casos de polinosis en 1954-1955, *Medicina clinica*, **26**, 100-108.

ALEMANY VALL, R., 1956b, Sensibilidad a la *Parietaria*, aspectos geograficos, clinicos y biologicos, Third Intern. Congress of Allergy.

KESSLER, A., 1953, Survey of airborne pollen and fungus spores in Israel, 1951-2, *Ann. Allergy*, **11**, 322-328.

KESSLER, A., 1954, Survey of airborne pollen and mold spores in Israel 1953, *Ann. Allergy*, **12**, 261-262.

KESSLER, A., 1958, Survey of airborne pollen and mold spores in Israel 1954-1955, *Ann. Allergy*, **16**, 445-450.

PARAG, Y., FEINBRUN, NAOMI AND TASS, J., 1957, Study in atmospheric pollen in Jerusalem in 1953-54, *Bull. Res. Counc. of Israel*, **60**, 5–17.

TAS, J., 1956, *Ailanthus glandulosa* as a cause of hay fever, *Ann. Allergy*, **14**, 47-48.

CORRIGENDUM

The explanation of Figures 2 and 3 in the paper by Parag, Feinbrun and Tas (1957, p. 12) should read:

"Graph of pollen catches in Station A (resp. B) *once in two days*, etc." instead of: twice daily.

TUBERCULINA PERSICINA (DITM.) SACC. ATTACKING RUST FUNGI IN ISRAEL

RIVKA BARKAI-GOLAN*

Department of Botany, The Hebrew University of Jerusalem

ABSTRACT

Tuberculina persicina (Ditm.) Sacc. was found on the aecidial stage of four different Uredinae. Pycnidia were not affected.

The presence of aecidiospores is not required for the germination of conidia of *T. persicina*. The highest percentage of conidia germination was obtained with material collected after 1 day, but germination ability remains for many months. Optimal temperatures for conidia germination are from 23–25°C. Light does not affect the per cent germination.

40–50% infection was obtained on the aecidia of the four Uredinae tested after 3–7 days at room temperature; infection never succeeded directly on leaves of the respective host plants, with or without preliminary treatments.

Cross-inoculation of *T. persicina* conidia showed that the fungus is apparently not specific to a special Uredinae; conidia from one rust species could induce infection on the aecidial stage of another species.

Different stages of the development of *T. persicina* on the aecidia were investigated.

INTRODUCTION

The fungus *Tuberculina persicina* (Ditm.) Sacc. has been reported in literature as a hyperparasite on a great number of Uredinae (Laubert 1925, Hulea 1939, Vladimirskaya 1939, Deacon 1939, Ulbrich 1941, Kirulis 1942, Rayss 1943, Keener 1954, Von Schroeder and Hassebrauk 1957, etc.). It was observed by the author on the aecidial stage of the four following rusts: *Puccinia aegilopis* Maire on *Anchusa strigosa* Labill.; *Tranzschelia-pruni-spinosae* (Pers.) Diet. on *Anemone coronaria* L.; *Uromyces limonii* (DC.) Lév. on *Statice limonium* L.; *Puccinia extensicola* Plowr. on *Inula crithmoides* L.

The purpose of this work was to investigate several physiological characteristics of the fungus: (a) to determine whether the spores of the hyperparasite are able to germinate by themselves or require the presence of spores of the host fungus; (b) to discover whether the fungus attacks healthy or weakened tissue of the host plant, and (c) to investigate the specifity of T. *persicina* to various rusts. In addition, the various stages of development of *T. persicina* on the various Uredinae were studied.

---

* Present Address: Agricultural Research Station, Rehovot.

Received September 22, 1959.

DESCRIPTION OF THE HYPERPARASITE ON ITS HOST

The aecidia which cause leaf deformation, appear as round or slightly oval spots, orange-rust in colour. Sori of *T. persicina* develop on the surface of these aecidia and form flat cushions of brown-violet powder (Figure 1). The cushions spread

Figure 1
T. persicina on spots caused by the aecidia of *Puccinia aegilopis* on a leaf of *Anchusa strigosa*.

rapidly on the aecidia which disappear completely within a few days. In a later developmental stage, many of the cushions become hard and take the shape of sclerotia. *T. persicina* has a pleasant smell, similar to that of jasmine.

T. persicina forms a dense palisade layer of conidiophores which are simple or slightly branched, septate, finely denticulate at the apices, almost colourless and 45–70 × 45μ in size. The acrogenously formed conidia are round, unicellular, smooth, usually 6–9μ in diameter, seldom attaining a diameter of 10–12μ. Single conidia are almost hyaline whereas in mass they are violet. The colour of a water suspension of the conidia also becomes violet within 7 days.

EXPERIMENTS AND RESULTS

Germination of Conidia

Germination of conidia in a hanging drop (Figure 2), with or without the presence

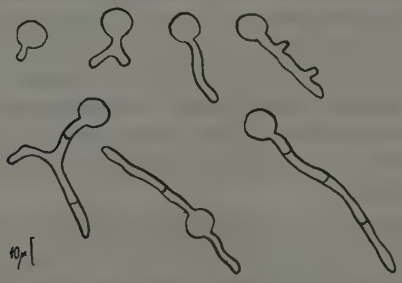


Figure 2
Germination of conidia in a hanging drop.

of aecidiospores, was high in both cases, thus proving that the presence of aecidiospores is not required for the germination of conidia*.

* Further examination in connection with conidia germination was therefore made without the presence of aecidiospores.

Conidia were collected from freshly picked leaves or from leaves kept in a room 1 to 5 days after picking. The highest percentage of germination was obtained from conidia collected after 1 day; percentage germination decreased gradually with conidia collected from leaves kept 3 days and more, but germination ability remained for many months.

At the optimum germination temperature (23–25°C), germination started approximately after 60 minutes. At a temperature of 16–18°C germination started after 3 hours.

There was no significant difference in per cent germination of conidia kept in daylight or in darkness, at the optimum temperature.

Infection Experiments

Infection experiments with the hyperparasite were made on the aecidia of the various Uredinae, as well as on host plants not infected with rust. Inoculations were made with a water suspension of conidia as follows:

(a) on healthy leaves of *Anchusa strigosa*, *Anemone coronaria*, *Statice limonium* and *Inula crithmoides*, which were first washed in running water and later dried;

(b) on leaves of the same plants which were wounded by needle pricking or scratching, washed with alcohol, ether or boiled water, prior to inoculation;

(c) on aecidia of the Uredinae on the above mentioned plants;

(d) cross-inoculation of *T. persicina* conidia taken from the aecidia of various species of Uredinae.

Negative results were obtained from the two first series of inoculations. In the third series, 40–50% infection was induced on all four Uredinae, after 3–7 days at room temperature. In the fourth series it was found that the fungus was not specific to a special Uredinae: cross-infection with conidia from the aecidial stage of one species to another was induced. It should be stressed, however, that unlike in nature, inoculations failed to cause total destruction of aecidia.

Histological Examination

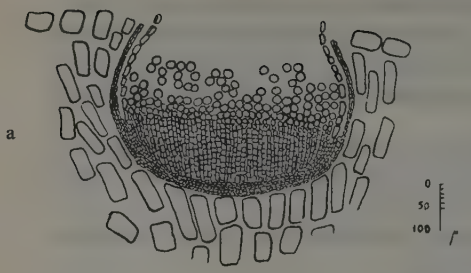
In order to study the different stages of development of *T. persicina* on the various Uredinae, histological examinations were made with the following material:

a. leaves infected with aecidia only;

b. leaves infected with aecidia recently attacked by the *Tuberculina*;

c. leaves on which the *Tuberculina* were very developed, and the aecidia barely visible, or not visible at all.

The methods used for histological study were fixation in Navaschin fluid (10 parts of chromic acid 1%, 1 part of glacial acetic acid, 4 parts of formalin 40%) and staining with Pianeze and cotton-blue (Riker and Riker 1936).



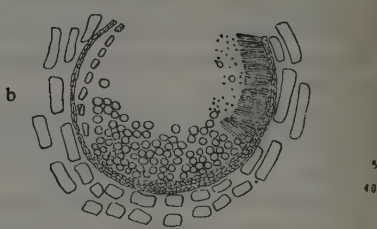


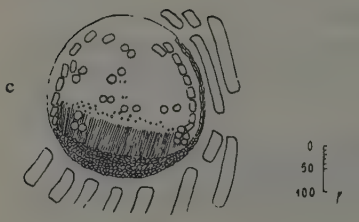
Figure 3 (a, b)

Stages in development of *T. persicina* on the aecidium of *Puccinia aegilopis*.

(a) An unattacked aecidium of the *Puccinia*

(b) Conidiophores of the *Tuberculina* cover a small part of the aecidium

The histological sections clearly showed various stages of the development of *T. persicina* on the aecidia. An unattacked aecidium is shown in Figure 3a. In the first development stage of the *Tuberculina* conidiophores covered only a small part of the aecidium (Figure 3b). In a later stage most parts of the aecidium were covered, but its normal shape was still kept. Some aecidiospores were still retained and the typical peridial cells were seen near the aecidial wall (Figure 3c). In a more advanced stage, the *Tuberculina* spread all over the aecidium (Figure 3d); the leaves appeared as if they were infected exclusively with *Tuberculina*, but examination of the section showed remnants of Uredinae, e.g. a few small aecidiospores, thinner than normal,



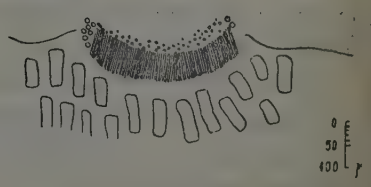


Figure 3 (c, d)

(c) Conidiophores of the *Tuberculina* cover most parts of the aecidium

(d) The *Tuberculina* spread all over the aecidium.

and a few peridial cells. In other cases, the pycnidial stage of the Uredinae, which is never invaded by the hyperparasite, was observed near the *Tuberculina* (Figure 4).

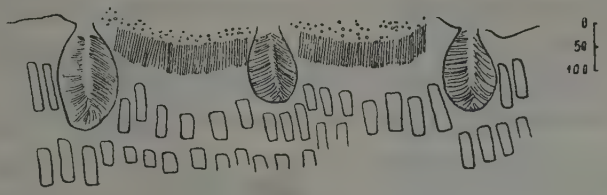


Figure 4

T. persicina in the place of attacked aecidia, near unattacked pycnidia.

Pianeze staining enabled us to differentiate between the two parasites and the leaf tissue: the leaf tissue was stained blue-green in colour and the parasites pink.

Cotton-blue staining made it possible to distinguish between the mycelium of the Uredinae and that of the *Tuberculina*. Both mycelia seem to be intercellular, but they vary in their thickness and are stained differently. Hyphae of *Puccinia aegilopis* are loose, stained brown and have a thickness 4–7μ. They penetrate into the host tissue and cause cell separation and eventual deformation of the leaf. Hyphae of *T. persicina* are stained blue and only 1–2μ in thickness. The mycelium spreads throughout the aecidiospores preventing normal growth. The greatest part of the mycelium is located in the vicinity of the aecidium. The few hyphae which penetrated to the intercellular spaces of the leaf tissue, increased the space between the cells which were already separated by the penetration of the rust.

ACKNOWLEDGEMENT

I wish to thank Prof. T. Rayss for her constant guidance and encouragement throughout this work.

REFERENCES

Deacon, G. E., 1939, Notes on a parasitic fungus attacking Rose rust, *Rose Annu.*, 136, *R. A. M.*, **18**, 528.

Hulea, A., 1939, Contributions à la connaissance des champignons commensaux des Uredinées, *Bull. Sect. Sci. Acad. Roumaine*, **22**, 1–19.

KEENER, P. D., 1954, *Cladosporium aecidiicola* Thuem. and *Tuberculina persicina* (Ditm.) Sacc. associated with *Puccinia conspicua* (Arth.) Mains on *Helenium hoopesii* A. Gray in Arizona, *Plant. Dis. Reprt.*, **38**, 690–694.

KIRULIS, A., 1942, Die mikroskopischen Pilze als natürliche Feinde der Pflanzen-Krankheiten in Lettland, *Arb. landw. Akad. Mitau*, **1**, 479–536.

LAUBERT, R., 1925, Haben die Schmarotzerpilze der Pflanzen natürliche Feinde?, *Gartenwelt*, **29**, 858–859.

RAYSS, T., 1943, Contribution à l'étude des Deuteromycètes de Palestine, *Palest. J. Bot. Jerusalem*, **3**, 22–51.

RIKER, A. J. AND RIKER, REGINA S., 1936, *Introduction to Research on Plant Diseases*, John S. Swift Co. Inc., St. Louis, Chicago, New-York, Indianapolis, U.S.A.

SCHROEDER, HILDA, VON UND HASSEBRAUK, K., 1957, Beitraege zur Biologie von *Darluca filum* (Biv.) Cast. und einigen anderen auf Uredineen beobachteten Pilzen, *Zentralbl. f. Bakt. Paras. Infekt. u. Hygiene*, **2**, 676–696.

ULBRICH, E., 1941, Hexenbesen und Hexenbesen-Rost an *Berberis vulgaris* L. und über die Gattung *Tuberculina* Saccardo 1880, *Notizbl. bot. Gart. Berl.*, **15**, 415–420.

VLADIMIRSKAYA, MME, M. E., 1939, A parasite of rust of cultivated plants, *Tuberculina persicina* (Ditm.) Sacc., *Bull. Pl. Prot., Leningr.*, **1**, 103–110, *R.A.M.*, **19**, 433.

CORRIGENDA

LIST OF FUNGUS SPECIES COLLECTED

PHYCOMYCETES
Mucor sp., section *Racemosus*
Mucor hiemalis Wehmer
Rhizopus nigricans Ehrenberg
ASCOMYCETES
Chaetomium sp.
Pleospora sp., *P. herbarum* group
FUNGI IMPERFECTI
Phoma humicola Gilman et Abbott
Phoma sp.
Pestalotia versicolor Speg.
Oospora sp.
Geotrichum candidum Link
Monilia sitophila (Montagne) Saccardo
Monilia sp.
Cephalosporium curtipes Saccardo
Cephalosporium humicola Oudemans
Trichoderma lignorum (Tode) Harz
Aspergillus clavatus Desmazieres
Aspergillus nidulans (Eidam.) Winter
Aspergillus variecolor (Berk. et Br.) Thom et Raper
Aspergillus ustus (Bain.) Thom et Church
Aspergillus sydowi (Bain. et Sart.) Thom et Church
Aspergillus versicolor (Vuill.) Tiraboschi
Aspergillus terreus Thom
Aspergillus carneus (V. Tiegh.) Blochwitz
Aspergillus niger V. Tiegh.
Aspergillus wentii Wehmer
Aspergillus tamarii Kita
Aspergillus flavus Link
Aspergillus ochraceus Wilhelm
Penicillium decumbens Thom
Penicillium chrysogenum Thom
Penicillium digitatum Saccardo
Penicillium expansum Link
Penicillium italicum Wehmer
Penicillium sp., *P. purpurogenum* series
Sporotrichum roseum Link
Sporotrichum sp.
Botrytis cinerea Pers.
Sepedonium xylogenum Saccardo
Verticillium sp.
Cephalothecium roseum Corda
Pullularia pullulans (de Bary) Berkhout
Hormiscium sp.
Torula chartarum (Link) Corda
Torula sp.
Stachybotrys atra Corda
Hormodendrum cladosporioides (Fres.) Sacc.
Hormodendrum hordei Bruhne
Helminthosporium sativum Pammel, King et Bake
Helminthosporium anomalum Gilman et Abbott
Spondylocladium sp.
Stemphylium botryosum Wallroth
Alternaria tenuis Nees
Alternaria humicola Oudemans
Alternaria sp.
Graphium sp.
Fusarium sp.
Epicoccum nigrum Link
Epicoccum sp.

Please insert this list instead of the list appearing in Vol. 6, No. 4 page 255.

CORRIGENDA

Volume 7, No. 2

p. 77, Table VI:

For	$R^2_{n.tl}$	$r_{n.tl}$	$r_{n.lt}$	r_{tl}	$R^2_{n.tl}$	$r_{n.tl}$	$r_{n.tl}$	r_{tl}
Read	”	$r_{nt.l}$	$r_{nl.t}$	”	”	$r_{nt.l}$	$r_{nl.t}$	”

p. 79 footnote: ***for*** **Table VIII** ***read*** **Table VII.**

יוצא לאור ע"י
מוסד ויצמן לפרסומים במדעי הטבע ובטכנולוגיה בישראל
המועצה המדעית לישראל - משרד החנוך והתרבות - האוניברסיטה העברית בירושלים
הטכניון — מכון טכנולוגי לישראל - מכון ויצמן למדע - מוסד ביאליק

Published by
THE WEIZMANN SCIENCE PRESS OF ISRAEL
Research Council of Israel, Ministry of Education and Culture
The Hebrew University of Jerusalem, Technion–Israel Institute of Technology
The Weizmann Institute of Science, Bialik Institute

Printed in Israel
JERUSALEM ACADEMIC PRESS LTD.
SET ON MONOTYPE

WSP/1000/12.59/28